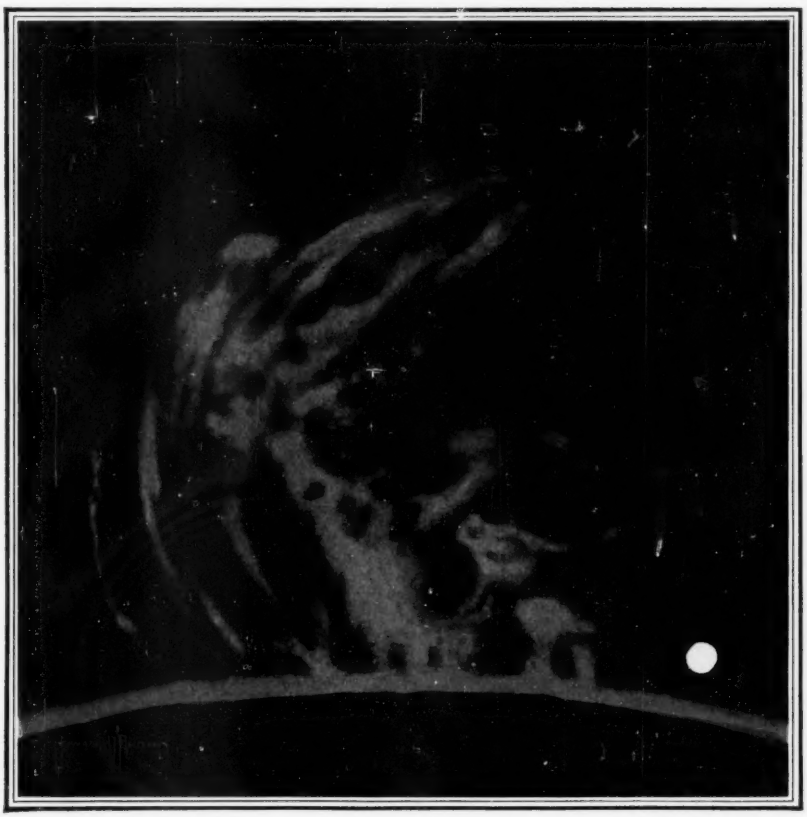
SCIENTIFIC AMERICAN

April 1929

35¢ a Copy

UNIV. OF MINNESOTA
MAR 29 1929
LIBRARY

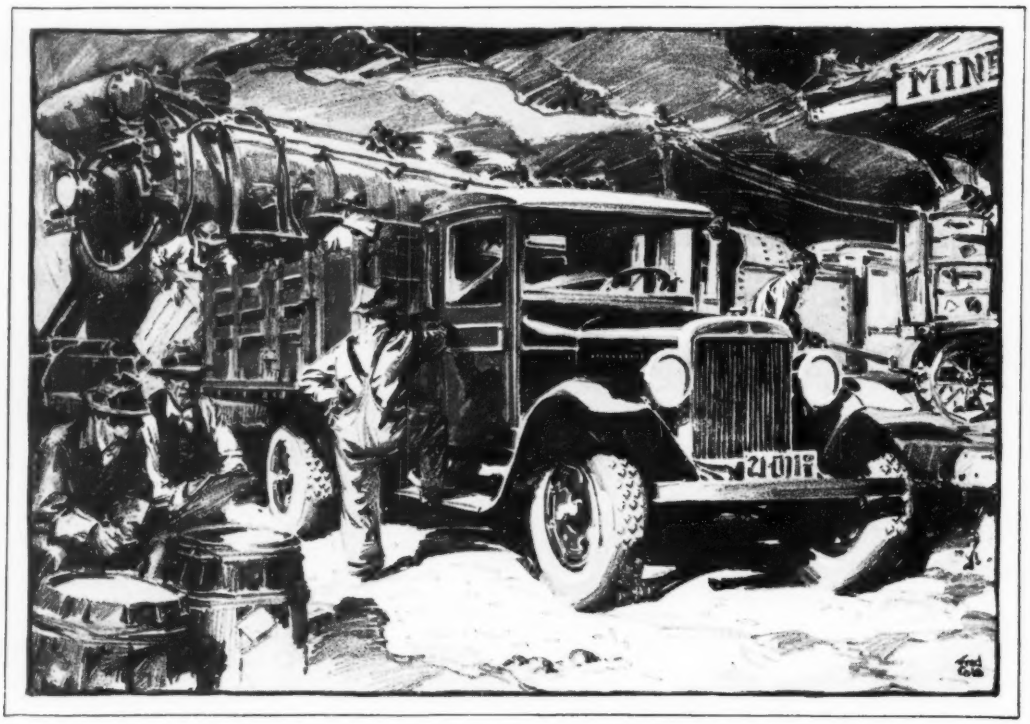


SOLAR RESEARCH FOR AMATEURS

THE ULTRA-VIOLET QUESTION

FOOD FROM WOOD PULP

DODGE BROTHERS TRUCKS



Set your own value standards ,, then apply them to a Dodge Truck ,,,

YOU know what you expect from a motor truck. You know the peculiarities of your business, of your loads, of the conditions under which you must operate—and you know them a little more intimately than any truck manufacturer can.

We know how to build good trucks . . . we build that kind—more than a million dollars' worth every week.

With sincere respect for your experience we ask your consideration of our truck . . . Set your own value standards . . . Fix on the speed you need, the power, the truck life . . . Set up your ideal for size, price, appearance, performance . . .

Then inspect the complete line at your Dodge Brothers Dealer's . . . You'll find your ideal truck, if it's anything under a 4-Ton, whether you want to haul bricks or bouquets, laundry or lumber, oil or anything . . . Body and chassis complete . . . Note the low prices made possible by great volume production. Ask your dealer about time payment.

Formerly Graham Brothers Trucks

The complete line of Trucks, Buses and Motor Coaches which Dodge Brothers have been manufacturing and selling under the name of Graham Brothers now take the name of their makers—Dodge Brothers.

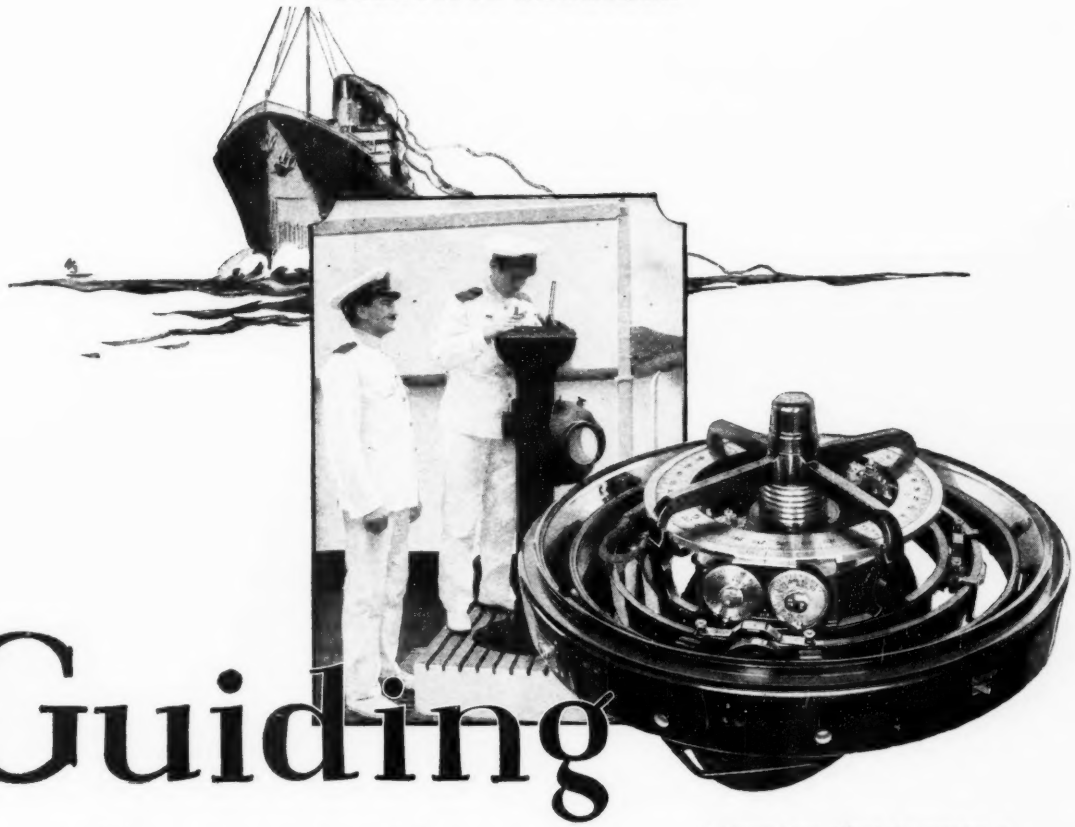
These Trucks, Buses and Motor Coaches have always been powered by Dodge Brothers engines. For years they have been built of Dodge Brothers parts in Dodge Brothers plants according to Dodge Brothers standards.

These Trucks, Buses and Motor Coaches are sold, as they always have been sold, by Dodge Brothers Dealers everywhere.

PRICES

MERCHANTS' EXPRESS—110″ w.b. . .	$ 665
COMMERCIAL TRUCK—120″ w.b. . .	775
1-TON—130″ wheelbase	995
1-TON—140″ wheelbase	1065
1½-TON—150″ wheelbase	1345
1½-TON—165″ wheelbase	1415
2-TON—150″ wheelbase	1515
2-TON—165″ wheelbase	1585
3-TON—133″ wheelbase	1745
3-TON—165″ wheelbase	1775
3-TON—185″ wheelbase	1845

Chassis f. o. b. Detroit



Guiding

great ships across trackless oceans —with the help of SKF Bearings

THE day of the centuries-old magnetic compass that guided Columbus to a new world, is going the way of the towering sails that he unfurled to the four winds.

And in its place has arisen a new mechanical marvel that depends not upon the attraction of that mysterious spot on the chart that is known as Magnetic North, but upon wheels revolving at terrific speeds in a miracle-working product of science that points to True North always.

And the Sperry Gyroscope Company, knowing full well the necessity for bearings that could be counted upon to stand up under all conditions of service, has selected for this newest and greatest aid to navigation

"The highest priced bearing in the world."

A Sperry Gyro Wheel that revolves at 8600 R.P.M. In a test conducted by the Sperry Gyroscope Co., SKF Bearings were in operation 24 hours a day for 747 days, a total of 8,734,848,000 revolutions — the longest continuous bearing run on record.

YOU MAY BUY A BEARING AS A BARGAIN BUT TRY AND GET A BARGAIN OUT OF USING IT *for*

Nothing is apt to cost so much as a bearing that cost so little

SKF Puts the Right Bearing in the Right Place

SKF INDUSTRIES, INCORPORATED

40 East 34th Street, New York, N. Y.

SKF

Ball and Roller Bearings

2223

Never the same job twice

YES, it's the same man shaving on ten different mornings; ten different conditions of water, temperature, and nerves; ten different methods of lathering and stroking.

But his Gillette Blade meets all these changing conditions with the same even temper

So much dependable shaving comfort has been honed and stropped into this blade that eight out of ten American men have learned to expect—and get—a comfortable shave even under the worst possible conditions.

To meet that expectation Gillette has developed and perfected some $12,000,000 worth of new machines during the past ten years. They condition the Gillette Blade far more delicately and precisely than even the most skilful artisan could sharpen a shaving edge.

Conditions vary. But the Gillette Blade is the one *constant* factor in your daily shave. Gillette Safety Razor Co., Boston, U. S. A.

THE NEW FIFTY-BOX. Fifty fresh double-edged Gillette Blades (10 packets of fives) in a colorful, useful gift chest. Five dollars at your dealer's.

* Gillette *

TRADE Gillette MARK

SCIENTIFIC AMERICAN

24 WEST 40th STREET — NEW YORK CITY

April 1929 — *Edited by ORSON D. MUNN* — *Eighty-fifth Year*

IN THIS ISSUE

CONTENTS—APRIL, 1929

A Factory In the Wilderness—By Walter S. Hiatt 297
Huge Quebracho Plant Is Built In the Heart of the Jungle

Our Light Plane Contest 301
Rules, Regulations, and the Committee of Judges

Solar Research for Amateurs—I—By George Ellery Hale, Sc.D. 302
New Spectrohelioscope for Observation of Sun's Phenomena

From the Scrap-book of Science 306
Camera Shots of Scientific Subjects

A Mountainous Earthen Dam 308
Largest Earth Fill Dam In the World for Hydro-electric Project

Exploring the Biblical Beth-shan—By Cornelia H. Dam 310
Stronghold at Crossroads of Ancient Highways Being Excavated

Boston's New "Madison Square Garden" 314
Railroad Station Combined with Huge Auditorium

Quantitative Analysis of the Sun—By Henry Norris Russell, Ph.D. 316
Quantitave Analysis of Chemical Elements of the Sun

Animal Allies of the Physician—By Walter E. Burton 318
Preparation of Vaccines, Snake Bite Serums, and Antitoxins

How People Differ Mentally—By Donald A. Laird, Ph.D., Sc.D. 320
Many of the Commonest Beliefs About Our Mentality Are Not True

New Uses for Coal and Wood—By Dr. Friedrich Bergius 322
Gasoline from Coal, and Food from Wood Wastes

Our Point of View—Editorials 325
Naval Half Truths; The Alloy Age; Sea Safety; Industrial Doctors

The Month In Medical Science—By Morris Fishbein, M.D. 326
Anesthetic Confessions; Tea Vitamins; Undulant Fever; Narcosan; Hair Grower; Man's Clothing; The Eye in Old Age; Japanese Decoration for Scientific Investigations

Why Do Insects Migrate?—By S. F. Aaron 328
More Controversy Than Knowledge Surrounds Their Flights

Safety for Those Who Go Down To the Sea In Ships 331
Rules and the Committee of Judges of Our Sea Safety Competition

Paper Milk Bottles 332
New Containers May Revolutionize Milk Distribution

Making the Farm Pay—By Frank M. Byers 334
Scientific Farming Discussed by a Practical Farmer

Ultra-Violet Transmitting Glass—Has It Made Good?—..... 338
By Albert G. Ingalls
A Discussion Based Upon the Opinions of Foremost Scientists

Household Inventions 344
Electric "Wife-Saver" 344
Stool Ladder 344
Tandem Toaster 344
Gas Cooking Cabinet 344
Folding Table with Benches 344
Fruit Juice Strainer 344

Accessories for the Golf Player 345
Ball Cleaner 345
Arm Support 345
Three New Tees 345
Weighted Tee 345
Ball Retriever 345
Golf Player's Umbrella 345

Scientific American Digest 346
Filling Station for Lighters 346
Arc-welded Hangars 346
New German Cruisers 346
Outboard-Motor Drainage Pump 348
Setting Poles with Dynamite 348
Steamer's Unloading Equipment 352
Soldering Glass to Metal 352
Conquering Pulpwood Fires 354
"Talkies" In the Home 354
Writing Japanese with Roman Alphabet 354
Making Photographic Reflections 376
Movie Actors Skate on Hypo 377

Learning to Use Our Wings 356
Planes On the Installment Plan 356
Curtiss-Caproni 356
The Aircraft Diesel Engine 356
To Panama By Air 358
Novel Fuselage Construction 360
Control Cable Substitute 362
The Verville Air Coach 362
Locking the Handley-Page Slot 363

Industries from Atoms 364
Destroying Wartime Gas 364
Synthetic Tannin Needed 364
Manufacturing Carbon Products 364
Pyroxylin Shatter-proof Glass 366
Metallizing Method 366
Hydrogenating Brown Coal 366
Oil and Water Mix Too Well 366
Uses for Soluble Silicates 366
New German Disinfectants 367
Toes as Weather Prophets 367
"Dope" Makes Money Last 373
Soft Coal Smoke Cost 374
Carbon Dioxide Fire Extinguisher 374
Soap Dust Explosions 375
Light Alloys Perfected 375
Gasoline from Natural Gas 375

Current Bulletin Briefs 368

The Back Yard Astronomer 370

The Heavens in April 372

Commercial Property News 380
Plymouth Is Merely Geographical 380
Oil Company Wins Parco Decision 380
New York Is a State of Mind 380
Collars and Collar Buttons 380
Putting Ideas to Work 381
End-Matched Boards 381
"Pullman" Bags and Pullman Cars 381
The American Beauty Contest 382

Patents Recently Issued 381

COVER

Our cover this month suggests what the amateur astronomer who builds one of the new Hale spectroheliascopes should be able to observe on the Sun—a great solar prominence, hot gases such as are frequently belched forth at tremendous velocities. The magnitude of this impressive spectacle may be estimated by comparison with disk of the Earth in one corner. See page 302 for Dr. Hale's article.

Closed—the Road to Waste

INDUSTRY need no longer travel the highways of Waste—paying exorbitant toll in high maintenance, misalignment, excess lubrication, underproduction, and premature wear.

For Timken Bearings, so successfully applied in all types of industrial machinery, have done away with all that—have revolutionized operating and maintenance costs throughout all Industry.

Saving power, saving lubricant, carrying both radial and thrust loads, increasing machine production, increasing machine life—it is little wonder that Industry is turning to Timken Bearings.

The exclusive combination of Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS*, and Timken electric furnace steel has closed the main road to Waste—and opened new roads to profit for machinery buyers who always apply the guide "Timken-equipped—wherever wheels and shafts turn".

THE TIMKEN ROLLER BEARING COMPANY
C A N T O N , O H I O

TIMKEN *Tapered Roller* **BEARINGS**

Scientific American, April, 1929, Vol. 140, No. 4, entered at the New York, N. Y., Post Office as Second Class Matter June 28th, 1879, under the Act of March 3rd, 1879; additional entry at Dunellen, N. J. Published Monthly by Scientific American Publishing Co., 24 West 40th Street, New York City. Copyright 1929 by Scientific American Publishing Co. Great Britain Rights Reserved. Subscription Price $4.00 per year.

Looking Ahead *With the* Editor

Plant Heart Beats

SIR JAGADIS CHUNDER BOSE, Cambridge educated Hindu, claims that plants have heart beats and nervous systems. He has written a book and articles on the subject and lectured much. Sir Jagadis, however, is a physicist, not a botanist; he merely *took up* botany. Botanists lay his claims at the door of Eastern mysticism. In these pages a scientific refutation of his supposedly proved theories will be published soon.

Vanishing Indian Medicine Men

INDIAN tribal "doctors"—the few that are left—possess secrets that are as mystifying as they are efficacious in the treatment of disease. The author of an article on hand has known a number of them, has studied their ways, and has attempted to learn some of their secrets but these medicine men refused to divulge them. The author presents an intensely interesting story that is entertaining and informative. Look for it.

Where the River Shannon Flows

THE River Shannon, famous in song and story, is being harnessed. A huge hydro-electric plant is being built upon it near Limerick. When this plant is finished, transmission lines will extend, like tentacles, to practically every nook and corner of the Emerald Isle, will carry modern light to scores of places dear to the hearts of Irishmen throughout the world, and will furnish power for industries that will thrive as never before. Our story of this great project is coming soon.

Tombs of Kings

FROM the University of Pennsylvania-British Museum Expedition comes word of many interesting new finds in the 5000-year-old cemetery of Ur of the Chaldees, now being excavated. Some of these have been called the most remarkable objects of antiquity that Sumeria has produced. A forthcoming article will describe the work of uncovering the remains of some of the old Chaldean kings and the many objects found.

Art and Science

NO doubt you have read many newspaper accounts of the trial of a famous art dealer for "slandering" a painting. Trusting his eye and his experience, he called it a copy, not a Da Vinci. Examining paintings scientifically, however, is another thing. An article ready for immediate release tells how it is done, how photomicrography and the X ray are used to determine the age of paintings and identify masterpieces of art.

Every Issue Fully Illustrated

¶ *Let the postman deliver the latest authentic news of science to your door once each month. He will do this if you subscribe to the* SCIENTIFIC AMERICAN. *And the cost is nominal—only four dollars a year.*

Among Our Contributors

George Ellery Hale

DR. HALE is one of the foremost international figures in astronomy. A noted authority on the sun, his chief work, perhaps, has been the organization of scientific endeavors. Two great observatories —Yerkes and Mt. Wilson —have been made by him, and now a third, with a 200-inch telescope, is to be begun. Dr. Hale is one of the best beloved men among scientists. His list of honors is far too long to be included in this brief note.

Cornelia H. Dam

MRS. DAM has spent much of her time, since graduation from Bryn Mawr, in archeological studies. She studied ancient Indian material at the Colorado State Museum, visited pueblos and ruins in the southwest and then returned to the Museum of the University of Pennsylvania where she has been Head Docent since 1925. Last year she visited the Near East, primarily to go over the museum's excavations at Beisan, but also to see the work of other expeditions.

Friedrich Bergius

DR. BERGIUS of Heidelberg, Germany, is the inventor of the most noted process of deriving liquid motor fuel and by-products from coal. Few realize, however, that the research which made this modern alchemy possible, began in his laboratory as long ago as 1913 and was pursued relentlessly through the World War period. If ever a case of laboratory research was vindicated by the promise of millions, it is this process.

Frank M. Byers

A GRADUATE of the Agriculture College of the University of Illinois, Mr. Byers taught chemistry and agriculture for four years and for the past 17 years has been manager of a large farm near Moline, Illinois. Thus his background of education, teaching, and practical experience lends authority to his discussions of farm problems. It is expected that his present article will be as widely quoted as was his first, Sept., 1928.

Ready...Waiting

Low Cost Power for Your Plant in *Southern California*

Surveys by foremost industrial engineers, market and financial analysts and business economists, show impressive and conclusive advantages to industry in Southern California. Your own investigation will prove to you that here is the most profitable location for your Pacific Coast plant.

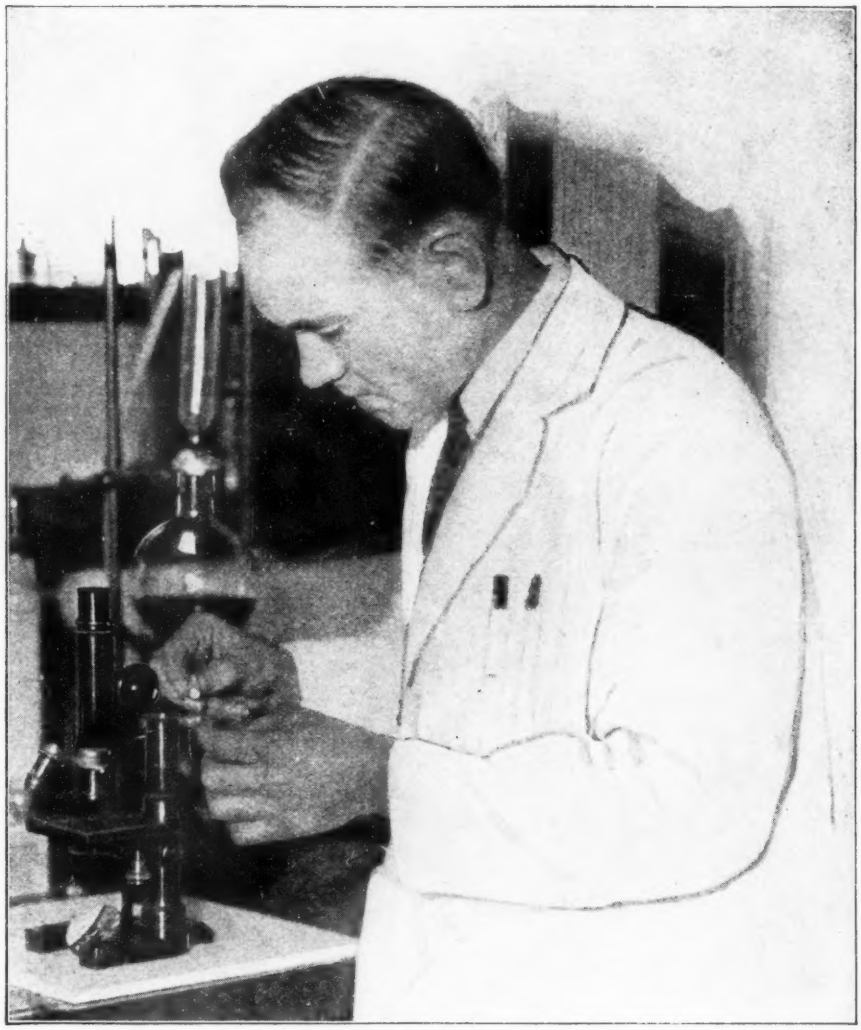
Southern California Edison Company is ready—waiting to deliver direct to your plant, anywhere you may locate it within the 55,000 square miles served by this company, all the electric power you want, at very low rates.

To keep pace with the growth of industry in Southern California, this company has an approved program of 1929 development involving an expenditure of $29,000,000. This will make a total investment of more than $320,000,000 in the generating and distributing system of Southern California Edison Company.

Production costs are lower in Southern California. The largest concentrated market on the Pacific Coast, with highest buying power, is at your very door.

Transportation facilities by rail, water, air and motor are unsurpassed. Plant Investment is minimized by equable climate. Labor conditions are ideal.

LOS ANGELES, CALIFORNIA



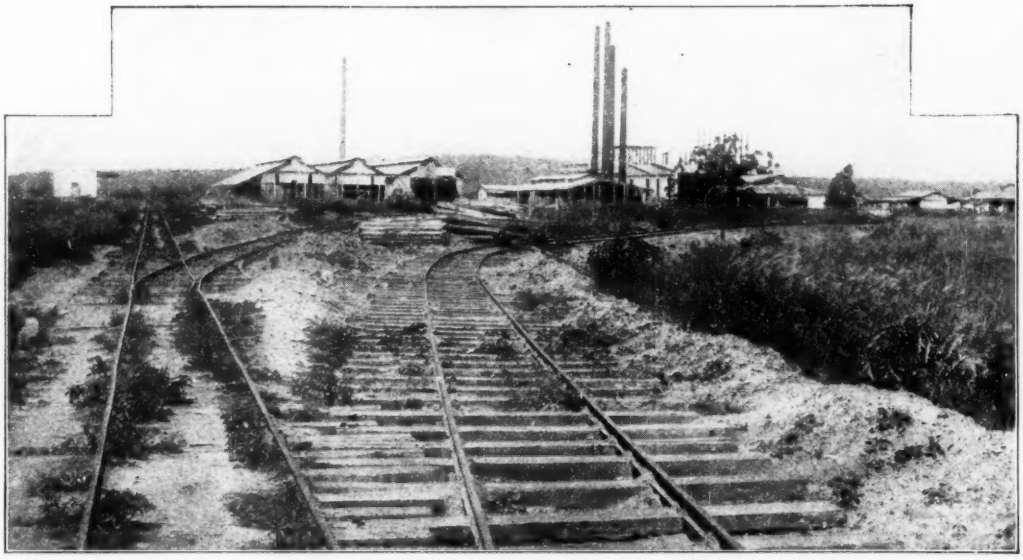
Doctor Oliver Kamm

THIS year the annual One Thousand Dollar Prize of the American Association for the Advancement of Science was awarded to Dr. Oliver Kamm, Research Director of Parke, Davis and Company, honoring his discoveries on hormones extracted from the pituitary gland. What Dr. Kamm has accomplished after much painstaking research is the isolation of two secretions called hormones (so-called "chemical messengers of the body") found in the back lobe of this tiny gland which is situated at the base of the brain. The front lobe of the pituitary gland, it will be recalled, regulates the growth and shaping of the body; dwarfs and giants owe their abnormality to its malfunction. The back lobe, Doctor Kamm has shown, produces the "alpha" hormone which is of value in obstetrical practice; also the "beta" hormone which regulates the amount of water in the tissues of the body. Some individuals are highly sensitive to this hormone; these people are usually fleshy. Others who are not so sensitive to it or whose supply is deficient are likely to be thin in spite of all the "stuffing" they may do in an attempt to put on weight. Dr. Kamm points out that the latter work is entirely in the experimental stage and warns that premature hopes should not be aroused. The significance of the discovery is that new physiological researches into hormone action have been stimulated and the entering wedge has been provided for a chemical study of the pituitary gland. What may result is unknown.

Courtesy The Museum of the University of Pennsylvania

Magnificent Basalt Panel from Beisan

DURING the seven seasons in which they have been engaged in excavations at Beisan, archeologists of the University of Pennsylvania Museum's expedition have found few examples of Palestinian sculpture there and those which were found heretofore were of a decidedly crude and inferior workmanship. For this reason the discovery of the panel which Mr. Rowe describes as the equal of the finest Babylonian and Egyptian sculpture is considered highly important. The fact that passages in the Old Testament refer to the presence of lions in the Jordan Valley during Biblical times also adds interest to the find. The panel, three feet in height, was found near the southern end of the great temple of the god Mekal in the Thothmes III. level, dating from 1501 to 1447 B.C. The panel is divided into two parts and is sculptured in high relief. An interesting article on Beisan will be found on page 310.



BANDITS WHO LAID THESE RAILS HAD NEVER SEEN A LOCOMOTIVE

This railway may not be quite as good as the one the Broadway Limited flies over, but when the desperados had finished building it through the trackless wastes of Paraguay it served the purposes of peaceful industry

A Factory in the Wilderness

With Bandits and Savages for Workmen, a Huge Quebracho Extract Plant Was Built in the Heart of the Jungles of Paraguay

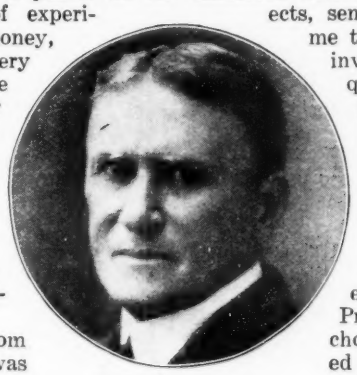
By WALTER S. HIATT

CONSIDER a few of the achievements in the career of George A. Kerr, leather chemist and master builder at home and abroad. He made savage Indians do the work of civilized man. He made the wilderness work for him. In nine months he built a dock, an iron and brass foundry and a huge carpenter shop, made seven million bricks, laid a railway line 60 miles long, rigged up 200 new ox carts, and then built a plant covering two acres, costing two and a half millions and turning out 70 to 80 tons daily of the quebracho liquid used to tan leathers.

KERR is of the new kind of frontiersmen whose work shows that the spirit of the old pioneers is not dead and that the world still has frontiers to be conquered. Then, too, he is one of those scientists who are doing so much for American industry. He has been working for 30 years in the leather industry, revolutionizing methods in tanning and dyeing, until he has come to be regarded as the only living expert in all branches of the industry. Step by step, year by year, he learned how to do things.

But let this man who brings things to pass tell his own story as he told it to me, in his own unaffected style.

Did you ever try to make wild Indians and bandits do the work of highly trained mechanics? asked Mr. Kerr. The job before me was to build a town, a railroad, and the world's largest tanning extract plant. To do this I had plenty of experience, unlimited money, promises of machinery to come, a flat piece of land on the upper Paraguay River, a small gasoline boat, two platoons of soldiers loaned by the Paraguay government, a meagre smattering of Spanish and no labor whatsoever.



GEORGE A. KERR

I was 350 miles from the nearest city. I was two months from my New York headquarters by cable, and three or four months by letter. I was 1600 miles from the Atlantic Ocean by river and much farther from the Pacific ports in a communication sense. There were not ten friendly white men in the surrounding area of 200,000 square miles of primeval jungle.

Because I am known not only as a research worker and consultant in leather chemistry but as a practical builder of model tanning plants, the International Products Company, once dominated by Perceval Farquhar, long identified with South American projects, sent for me and asked me to help in a plan that involved wresting the quebracho industry from Germany. With higher cost of production and the vanishing of the American chestnut, quebracho is the wood now most widely used for vegetable tanning. Previously, the quebracho logs had been floated down river to Atlantic ports, shipped to the United States and to Europe, and there ground up. The new plan was to use a forest concession costing two million dollars and to put up a plant at the wood source.

I estimated costs, ordered the necessary machinery, a good supply of tools, camp building materials, plenty of

tinned foods, medicines, some small arms, and materials for a railroad, and set out. I took steamer and decided I could find my labor at points close to the scene of operations. When I came to Asuncion, capital of Paraguay, I was brilliantly entertained by the president and the leading business men and politicians. They congratulated me on my courage, but said gently, "Excuse us, Senor, it can't be done. Why not stay awhile among us, build your plant here, and enjoy life and safety? Believe us, we know our country, and none of us has ever gone where you propose to go." The English and Americans I met said, "It just can't be done. You are not back home where skilled hands are to be had. People here never work. The very thought tires them. Why should they? Nature gives them all they need to eat, they do not require many clothes, and the cooking, the washing, and the planting are done by the women."

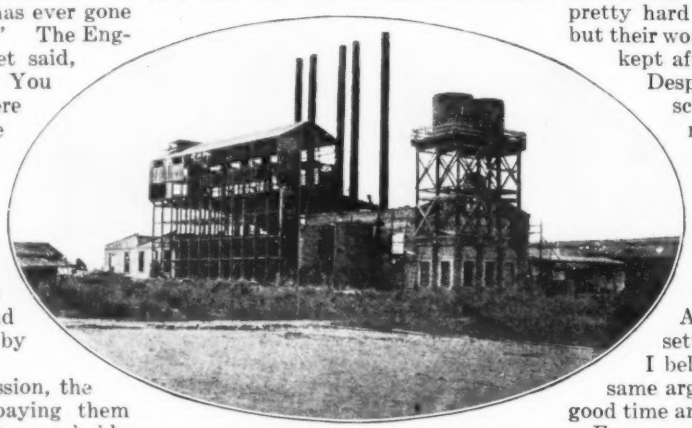
Finally I got a concession, the loan of some soldiers, paying them wages, of course, which they probably wouldn't otherwise get. They had a fine, faithful officer in command, and when I took the next boat up river we made quite an imposing party. All the officials and white men of the city gave us a grand send-off and wished us a quick and safe return. They were pretty sure I wouldn't be long.

AS I went along I established a line of communications, and learned all the lore they had about fevers and Indians and the jungle. The higher up river I got the more discouraging were reports about workmen. Of course, I made friends with the river boat captain. He was one of my communications to the rear, and either he or one of his friends would have the hauling of the machinery and gear that was to be shipped.

Up river, a hundred miles or so, at the triangle formed by the junction of Bolivia, Brazil, and Paraguay, the captain told me, were two towns, Suarez and Martinho, pirate ports where foregathered all the bandits, outlaws, and escaped convicts of the three countries. He would bring me some of them, he promised, if I would pay their passage money and give him a bonus. He smiled darkly when I asked him how he would do it. I didn't press him. That was his affair. "They won't work and they are dangerous, and I advise against it, as a friend, but if you insist, they are yours," he said. I gave him an advance.

After he went on I set about preparing a camp for myself and the soldiers. As a safety measure we built a rude and temporary blockhouse of logs, mud, and palms in the middle of a clearing and close to the river bank, so that we could command any attacks from that direction. We also built a rough storehouse for my baggage and in that I lived for the time. We next put up a long rude shelter at a distance of 50 yards for the first workmen who would arrive.

Within a week my boat captain returned. When he drew alongside the bank I saw by the smile on his face he had been successful. He sent ashore about 50 of the roughest men I have ever set eyes on. And they had their women with them. That looked bad for it meant fights over them, yet I knew enough about human nature to believe those women would help me get work out of them.



IT STANDS ALONE

No other factory is within 1000 miles of this huge South American tanning extract plant

These ruffians swaggered ashore with their bundles, their arms, and their fighting cocks, and began a clamor for food and quarters. We made each man pass through the blockhouse, and there we took his name, his trade, if any, and his knives and pistols. When the last man had passed through we sent a lot to the shanty prepared for them.

THEY slunk away, growling, threatening, swearing horribly. My friend the river captain nudged my arm and whispered: "I explained that you were a rich and foolish American who actually expected people to work, that if they came here they would get plenty of food, and hinted there might be some loot, when they got tired of their holiday. And now you have spoiled their plans."

Now I had my working nucleus. But I realized those men would never do an honest day's work if they were not outwitted. So I went to them with a guard of soldiers and had it explained to them that they were to be well treated, well fed, and well paid. In return I wanted their friendship and aid. If I did not get that I would shoot or have shot any man who revolted. I then called together the women. I explained to them that if they made their men behave they would each get a new dress and a present each week. If their men beat them, I would punish them. If their men didn't work, there would be no food.

I set the men to work building a street lined on both sides with separate cabins—a home for each man and his wife. I detailed men or their women to keep the streets clean, and set up fines for throwing filth about. It came pretty hard to those fellows to work, but their women kept after them, and I kept after the women.

Despite the it-can't-be-done school, the ground work of my plan, labor, was laid. My captain brought me another lot of men, and every captain who stopped was offered the same terms. Pretty soon these vile ports up river were getting depopulated. As nobody could leave the settlement to carry word back, I believe each captain used the same argument—idle living, food a good time and, eventually, loot.

From now on nearly everything I did was done backwards. I had my town almost built before I had any productive work for my men to do. Indeed, I began to fear my machinery would not come in time to give them any real work and thereby save their souls and my big job. The first thing for such a job, of course, should have been the building of a landing stage. With insufficient tools, I had the men cut down some straight trees, trim them, saw them into 30-foot lengths and roll them to the bank. It wasn't easy. There seemed to be 18 feet of water at the bank, but underneath the river bed there was about 30 feet of soft mud. When I sank a pile it just kept on going. I had to splice two together to find bottom. However, one way and another we got a strong dock built.

THEN it was up to me to find more work for the men, while I was waiting for the machinery and supplies. When I had decided to wait about another week or two and let them enjoy a holiday, the food supply gave out and there was trouble. So I knocked the tops off a dozen boxes of tea biscuits and served that as rations. I next hurriedly organized my commissary, sent some soldiers out to buy a few dozen head of cattle, arranged with the Indians for a steady delivery each week, built a slaughter house, and staved off famine and riot.

Meanwhile, I had been waiting for the fruition of my plans to build cement foundations for my two-acre factory. My own cement didn't come

and I received word from Asuncion and other places that cement couldn't be had in quantity until next year. Next I lost time in trying to buy bricks. But no bricks were available, and, anyway, so the word came back by river steamer, no masons could be had to do the work.

I decided to make my own bricks. Good or bad, the work would keep the men busy. I conferred with river captains. They said nobody had ever made brick out of *chaco* clay. Therefore, it couldn't be done.

ANYWAY, great quantities of straw and manure were needed to mix with the clay, as was the custom of the country, and where would I get the necessary huge amounts of such material? I learned how to make bricks, however, 20 years earlier, out in Columbus, Ohio, on the banks of a river. As a trial I took some of the camp clay and mixed it, set it into forms and dried out the model pieces in a miniature kiln. The result was bricks.

I then set the men to work in gangs, some digging foundation pits, some making a carpenter shop, some a big kiln, some making barrels to bring up river water. Everything went at once. There was no beginning and no ending. The men did what I told them, rather patiently by now, and few made mistakes after they had learned what I wanted and how to do it. The very fact that they were unskilled was a help, as they had nothing to unlearn.

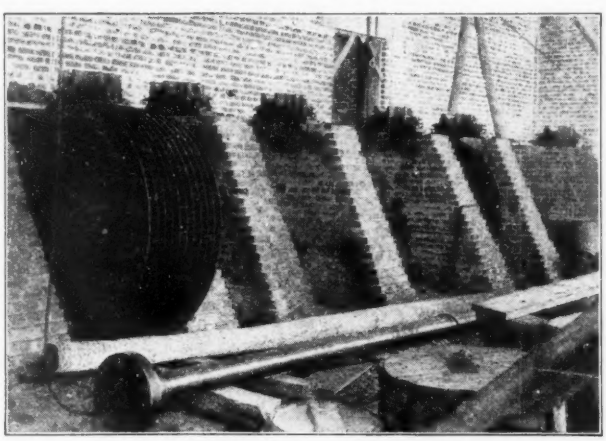
The machinery for my plant began coming along in driblets. When my 17-ton extract boilers arrived, sent up river on a lighter, I had only a 5-tone crane to lift them ashore. If the crane had broken under the triple weight, these boilers would have gone into the river.

It was just one chain of bad jobs after another. When I got up in the morning I did not know what new disaster awaited me. When, for example, I got the boilers safe ashore, I found all the brass parts had been stolen. So I had to build a brass and iron foundry to make new parts. Most of my machinery arrived incomplete. The steel frames for my plant had been taken from airplane hangars in the United States and, of course, were makeshifts. During the voyage the ship had caught fire and the heat had twisted the frames out of shape. I had to make the peon blacksmiths straighten them.

The iron waterpipes for the plant were stolen in shipment. I had to make and use wooden ones. I had to do all the thinking and about one twentieth of the physical work for a settlement that now consisted by the third month of nearly a thousand people.

One day a soldier reported that an American cowboy was in a canoe at the landing and wanted to come ashore. As I had given strict orders that no one should enter or leave camp except on permission, I was asked what should be done. I went to the landing and looked the man over. He was tall, lanky, brown from sun and weather, physically in good trim, and with a pleasant grin on his face. "My name is Ike," he called, "and I was wondering about stopping here, sort a-lookin' for a job." I didn't ask him, even by way of form, where he was going, where he came from, his last name or why he was there. That would have been bad form indeed. Rightly, I concluded he was a fugitive from justice.

"COME ashore, and have something to eat," I suggested, as his looks pleased me. Here at least was a man who could talk my language and understand what I was doing. If he measured up, he was more precious than fine gold. But I couldn't let him suspect this. We talked for a time. He showed no surprise at the gigantic job I had undertaken, offered no advice. He knew the country. We struck an agreement, and he showed such quick intelligence, reliability and sturdiness that he became my assistant chief engineer, although he knew not one thing about engineering in the expert sense.



"IT COULDN'T BE DONE"

So said the natives, but Kerr succeeded in making millions of bricks of *chaco* clay which water wouldn't wash back into mud

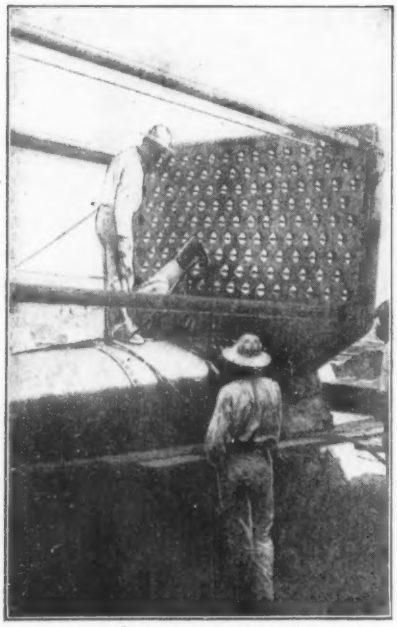
Slowly the building, which as completed stood 75 feet high, with standpipes and chimney stacks 125 feet high, rose in the clearing. When all the machinery was in place I put on the roof. For this, as I had no girders of steel, I had to make my own supports of wood. To get the men to raise those standpipes high in the air was a hard job, and I had to bribe them with triple pay.

Next, I had to begin to get in my quebracho wood to feed the plant. To do this I had to build a railroad reaching back 60 miles into the forest. I had never built a railroad, nor operated a locomotive. Yet, I had to teach men who had never even seen one, get them to build grades, cut ties, lay and bolt rails in place, spike them, and operate the locomotives. Had they known what dangers I led them into, by boiler explosions, either at the plant or on the rails, they would surely have deserted.

ONE way or another, at the end of nine months the plant was turning out 60 to 70 tons of quebracho extract daily. It was at this period that all my work was threatened. With the slackening of the hard work and suspense of getting the plant to operate, the men grew restive. There was an attempt to murder me as part of the old plan of the pirate towns for loot. While I always went armed, always closed my house tightly at night, and watched my food against poison, I could never be entirely safe against men whose work required them to carry machetes, the universal hand tool of these countries. The danger came upon me because I had extended operations far outside of Puerto Penasco, the name I had given the settlement.

As the first practical scientist and white man to explore that country for its commercial possibilities, I had to roam on horseback over great distances, accompanied, of course, by a personal bodyguard. On such occasions the camp was left in charge of my soldier captain, upon whom devolved the task of keeping order. On one of my journeys to replenish the herd of 25,000 cattle which I maintained as a stock to draw upon to feed the workmen, I was followed by a group of savage Indians who signified, by dropping arrows in front of me, that I must not penetrate the pampas farther. Hiding in the tall grass they used this customary warning to make me turn back. My horse fell into a bog and threw me. In the dusk I saw signs of many jaguars, pumas, and *gato de monte*, ready to fall upon my party and myself. We set a watch for the night and with the dawn turned back.

When I reached Puerto Penasco I scented trouble. The work was going along haltingly. The night before some of the men had broken into the whiskey and wine rations. That night I closely barricaded my own quarters. Early in the night I was awakened by



ONE OF THE BOILERS

The boilers were shipped to Puerto Penasco knocked down, and were assembled in position

a scuffling, and through a porthole saw a mass of men slowly closing in on my quarters. I threw open the door and made for the group, shouting to the soldiers not to fire.

I demanded to speak to the leader. One of the men began a speech. I asked him if he had any complaint. Did I not do more work than anybody? I asked. Did I not provide food, pay well, treat the men well? These words of mine pleased the other men. Then I seized the man, took away his machete, and marched him to the soldiers' quarters with orders to lock him up.

The next day work was resumed, but I knew the incident was not finished. I doubled the guard about the motor launch. To keep it in my control was vital as a means of sending word down river in case of any real outbreak. Soon, I got a clue to the whole matter and found there was a plot afoot. An Englishman rancher had befriended and cared for a native woman and her family. They told him that the pirate towns up-river were planning a descent on my settlement, this rancher, and even some of the down-river villages and the big town of Concepcion. They had secured a small steamer for their raid. He sent this information by letter and told me he was fleeing.

I DISPATCHED my motor launch to warn Concepcion and to ask for more soldiers. Meanwhile, I put my soldier captain on his guard, as well as all the foremen I could trust. I knew, however, that in a real attack I should be helpless, with 50 soldiers against several hundred armed and desperate men, bent on loot and able to fire from a steamer, perhaps armed with cannon or machine guns. Nevertheless, I was determined not to lose the fruits of my nine months' work and have my plant and my organization destroyed.

I could take no chances with arming any of the workmen, as they would be too ready to turn against me and rob the stores. I had taken this risk since the beginning. My mind was therefore prepared for the attack, which I realized must come sooner or later. By the curious grapevine intelligence of the natives, there was not a soul among the workmen who did not know of the planned attack. I knew this by their attitude—unusually complacent and obedient, biding their time to make a break for what they considered freedom.

BY great good luck, after two nights of waiting, a small steamer came from down-river in answer to my call for help. There was a handful of soldiers on board. Hardly had it stopped before my plan was ready. I determined instead of waiting the attack, to attack myself. I got aboard with a dozen of my soldiers, plenty of rifles and ammunition, and bribed the captain to take me to Suarez and Martinho.

We crept in to these ports by night and found the pirates had not yet started on their expedition. We went alongside the steamer they were planning to use, quietly knocked on the head the men in charge, bound them, and so disabled the machinery of the engine room that the steamer was out of commission for many weeks. I knew that by that time the pirates might abandon their plan, realizing that I would bring up a larger body of soldiers to Puerto Penasco.

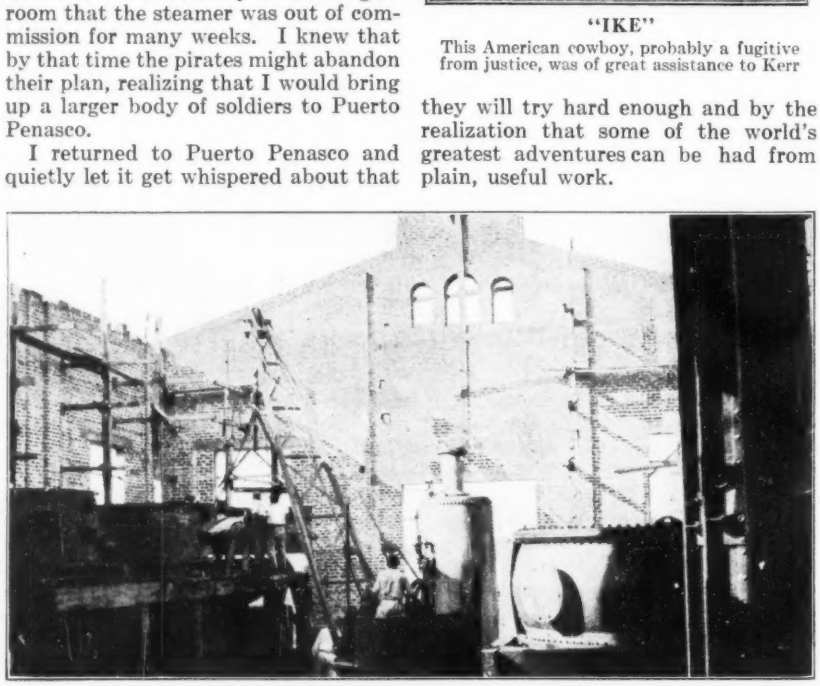
I returned to Puerto Penasco and quietly let it get whispered about that another force of soldiers was arriving, although I knew I would not get them because of the slow ways of the country, and, indeed, I didn't want them about. There were, in fact, no more attacks planned on me so far as I knew during the rest of my stay in Puerto Penasco.

After this display of force, things at the extract plant went along with comparative smoothness, and the output assumed the steady flow of a well-organized plant.

When I was relieved, with my job done and the plant in good order and ready to turn over to an operating manager, I came away with regret, but enriched by the knowledge that men may do the seeming impossible if they will try hard enough and by the realization that some of the world's greatest adventures can be had from plain, useful work.

"IKE"

This American cowboy, probably a fugitive from justice, was of great assistance to Kerr



EVERYTHING DONE TOPSY-TURVY

To keep all hands too busy for trouble, each job had to be done when it could; the machinery for extracting the tanning liquor was being installed in the factory before the roof was put on

Courtesy Moth Aircraft Corporation

Our Light-Plane Contest

Complete Details of the Scientific American 500 Dollar Prize for a Light Airplane Design

ONE of the most promising aspects of American aviation is the increasing interest of the public in the light plane for private ownership. In England there are now over 30 flying clubs, employing light two seater planes exclusively. Members of these flying clubs think nothing of extensive trips over the whole of Europe. Flights in light planes have been made from London to Cape Town, and from London to Australia.

With the rapid increase in the number of airports and landing fields in the United States, and the vast distances in this country uninterrupted by customs or geographic barriers, the large number of flying schools now in operation, and the enthusiastic interest of young America in all things pertaining to aviation, there is not the slightest doubt that private and sports flying will assume large proportions.

The primary requirement for private flying is a suitable light plane design.

As we announced last month, thanks to the generosity of Colonel R. Potter Campbell, President of American Cirrus Engines, Inc., the SCIENTIFIC AMERICAN now offers a prize of five hundred dollars for the best design of a two seater plane submitted under the following rules of competition:

1. The design is to be for a two-seater light plane around the Cirrus Mark III engine, specifications of which are:

Type	Four-cylinder-in-line, vertical
Number of cylinders	Four
Cooling	Air
Normal b. hp.	88 at 1900 r. p. m.
Maximum b. hp.	95 at 2100 r.p.m.
Weight dry	280 lb.
Direction of rotation	Clockwise
Ignition	Two magnetos
Length overall	46.5 in.
Height overall	37 in.
Width overall	17 in.
Bearer centers	Front 15–½ in.
	Rear 19 in.

Cowling and installation diagrams of this type of engine will be furnished by the Committee upon request.

2. The design is to be one for a plane which will be most suitable either as a training plane or as a sport plane for private ownership.

3. Minimum equipment allowed by the Department of Commerce in the way of instruments will be required.

4. The fuel supply shall provide for five hours at full throttle.

5. Provision for 50 lbs. of baggage and a baggage compartment.

6. Minimum gliding speed of 40 miles per hour. Maximum speed to exceed 95 miles per hour.

7. No restrictions are to be placed on the type of design. The fuselage shall be of metal construction, but the wings may be of wood construction.

8. Each competitor for the prize will be required to submit the following information:

a. Three views of plane and main dimensions and characteristics.
b. Detailed weight estimate.
c. Balance diagram and stability and control considerations.
d. Preliminary performance calculations.
e. Preliminary stress analysis.
f. Drawing showing power-plant installation with gasoline and oil system.
g. Drawing showing accommodations for pilot and passenger.
h. Sketches or preferably drawings illustrating the structure of the plane, wings, fuselage, tail surfaces, landing gear, and controls.

9. Drawings and data (preferably in typewritten form) should be in the hands of the judges on or before August 15th, 1929.

10. The following system of rating will be adopted:

General suitability of the plane for training and private ownership purposes and general excellency of the design	20 points
Performance	15 points
Power plant installation	15 points
Construction and ease of maintenance	80 points

All drawings and data will have to be submitted in triplicate.

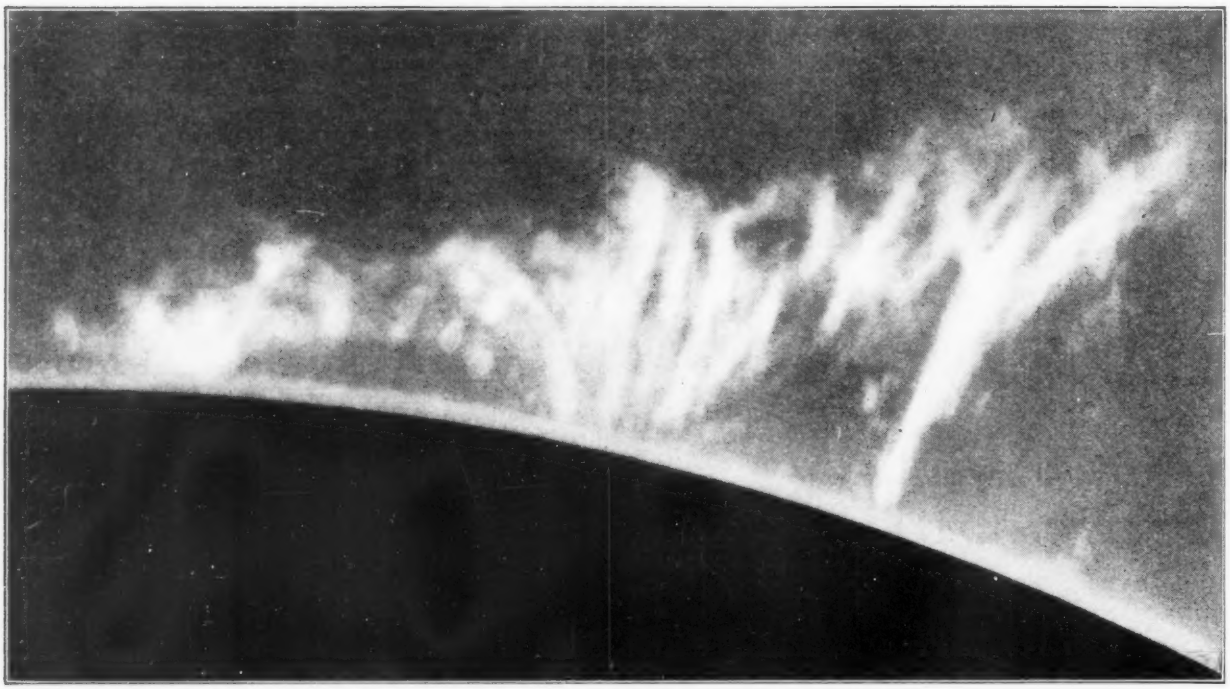
In addition to the cash prize, the judges may award one, two, or three honorable mentions.

All drawings and designs will remain the property of the designer, but the designs of competitors receiving the prize or honorable mention may be published in the SCIENTIFIC AMERICAN.

The judges have been selected so as to cover varying phases of the problem and include:

Miss Amelia Earhart,
Mr. George Palmer Putnam, of G. P. Putnam's Sons, private plane owner,
Professor Alexander Klemin, of the Daniel Guggenheim School of Aeronautics, New York University.

All communications regarding this competition should be addressed to the Committee, Light Plane Design Competition, Scientific American, 24 West 40th Street, New York City.



SOLAR PROMINENCES. THE MAXIMUM HEIGHT SHOWN IS 80,000 MILES

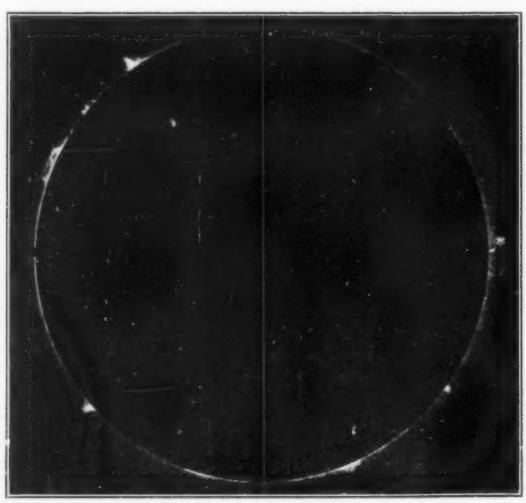
Solar Research for Amateurs—I

By Means of the Newly Developed Spectrohelioscope, Vivid Phenomena on the Sun May Now Be Observed in Motion by the Amateur Scientist

By GEORGE ELLERY HALE, Sc.D.
Honorary Director, Mount Wilson Observatory of the Carnegie Institution

NO chapters in the history of science are more inspiring than those that recount the discoveries of the amateur. Hampered, it may be, by lack of equipment, situated where conditions for research are not of the best, and often compelled to devote his best hours to other pursuits, the amateur, rising above all discouragement, has continued to pour a flood of new ideas and significant observations into the ever-widening sea of scientific knowledge. Many a great name is associated with a modest beginning, and many a discovery has been made with inexpensive apparatus. Intense interest and persistent purpose naturally bring their own reward.

The amateur thus has a great advantage over the perfunctory toiler, driven into research by someone who thought it might prove interesting, or lured on by a desire for fame or fortune. His eye is not fixed on patents or prizes, decorations or degrees. He works because he cannot help it, impelled by a genuine love for his subject and inspired by an irresistible influence, which he seeks neither to justify nor to explain. His reward lies in the work itself and in the hope that it may contribute something to the advancement of knowledge. If there is any means of deriving greater satisfaction from personal effort one must go a long way to find it.



SOLAR PROMINENCES

Photographed in full sunlight with the spectro-heliograph. Taken on Mount Wilson with the red hydrogen line ($H\alpha$), September 21, 1909. (The image of the Sun's disk was covered with a circular metallic screen)

It naturally follows that the world owes an immense debt to the amateur. His compelling interest, never flagging through the years, often leads to important advances. Thus, Schwabe, the apothecary of Dessau, recording sun-spots day after day for 43 years with his small but "imperturbable telescope," discovered that their number waxes and wanes in the now familiar sun-spot period. Burnham, busy all day as a Chicago court stenographer, discovered nearly 500 new double stars with a six-inch telescope in his back yard. Huggins, in spite of the smoke and fog of London, borrowed instruments from the Royal Society and laid the foundations

of astrophysics. Herschel, the organist of Bath; Barnard, the Nashville photographer; Lockyer, the War Office clerk; Bond, the watchmaker of Maine; Schumann, the Leipzig machinist; and many others, limited in time or means, have also left their names in the permanent roll of scientific discoverers. Darwin, Faraday, and Rayleigh, though they gave their whole lives to research, were essentially amateurs, members of a guild devoted supremely to science and never to be confused with the idling dilettantes of the popular imagination.

While it is still possible in many fields to contribute to knowledge with the aid of small instruments of standard design, the wise amateur quickly takes advantage of favorable opportunities to enter untrodden territory. Thus while routine observations of variable stars visible with a small telescope are very valuable, the amateur who attaches a thermocouple or photoelectric cell to his equatorial can detect and measure much smaller light-variations than the eye can see, and thus discover new and important phenomena. The work of Stebbins is a fine illustration of this. A similar opportunity for entirely new work, due to the recent development of the spectrohelioscope, now exists in the field of solar research.

FROM whatever angle you look at it, the Sun offers interesting and remarkable subjects for investigation. Unlike most celestial objects, the brilliant and spectacular phenomena of its atmosphere are never twice alike, and the most violent outbursts of terrestrial volcanoes are tame affairs in comparison with solar explosions. In order to gain any conception of the fantastic beauty of solar prominences it is necessary to see them in action. As Secchi has said in his book on the Sun, it is impossible to reproduce "the vivacity of color of these enormous masses, or to depict their rapid motions when they are shot by eruptions from the interior above the surface of the Sun. The best drawings are inert and lifeless when compared with the actual phenomena. These incandescent masses are vivified by internal forces which seem to endow them with life; they glow with intense brilliancy and their colors are so characteristic that they enable us to determine spectroscopically the chemical nature of their constituent gases."

AN ERUPTIVE PROMINENCE

Photographed with the Kenwood spectroheliograph, Chicago, March 25, 1895, 10h 40m A.M. Height of prominence, 162,000 miles. Compare with photograph above

Such brilliant phenomena are striking enough in themselves, but their relationship to terrestrial disturbances makes them doubly important. If you are interested in radio, or the aurora, or terrestrial magnetism, you will want to learn the source of the electrified particles which are shot from the Sun into the Earth's atmosphere, where they arouse the Northern Lights, initiate magnetic storms, affect radio transmission, produce powerful earth currents in telegraph lines, and sometimes puncture Atlantic cables. They are popularly supposed to come from sun-spots, but some of the largest spots produce no such effects and attention should be directed to the occasional eruptions, occurring on the disk near certain types of sun-spots, which the spectrohelioscope now renders visible.

110 MILES PER SECOND

The prominence shown at left below, photographed at 10h 58m. Height, 281,000 miles

If the nature and evolution of the stars appeal to you especially, remember that the Sun is the only star near enough the Earth to be studied in detail. To see the other stars as we do the Sun, to discern their huge disks, the spots on their surface, the flames in their atmosphere, it would be necessary to approach them closely, and there is no prospect that any telescope, however powerful, will ever make this possible. The larger and more perfect the instrument and the better the atmospheric conditions, the smaller their needle-point images appear.

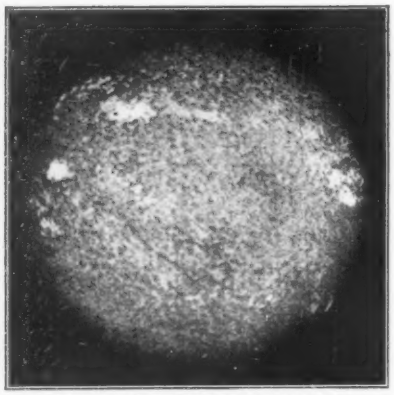
How fortunate, then, that one star is so near at hand! This neighboring object, our own Sun, is proved in a score of ways to be a perfectly typical star, similar in chemical composition, in size and in structure to millions of other stars in the remote distances of space. It is so near us that any telescope will show its disk and the spots that come and go on its surface. These and its other phenomena are most varied in character, constantly changing in number and in form, and suggesting problems of every kind for solution. Moreover, with the aid of a spectrohelioscope, the amateur will be able to observe, not merely the spectacular outbursts of the chromosphere and prominences encircling the Sun's circumference, but also the little explored region of the solar atmosphere now visible in projection against the disk. Here is a new field, open to amateurs, for discoveries of prime importance, which will aid in solving many puzzling problems of solar and stellar physics.

A QUIESCENT PROMINENCE

A slowly changing or "quiescent" prominence, 110,000 miles high. Photographed at Mount Wilson with the $H\alpha$ line, 1927

The Sun may also be regarded in still another aspect, the importance of which has recently been greatly enhanced by the revolutionary progress of physics and chemistry and the rise of the Einstein theory of relativity. In an article on "The Sun as a Research Laboratory" (*Journal of the Franklin Institute*, July, 1927) I have recently pointed out some of the fundamental advances in physics which are the direct result of solar discoveries.

AS a matter of fact, the Sun is an immense furnace, with a surface temperature of about 6000 degrees, Centigrade, and an internal temperature reaching millions of degrees, sufficient to strip the atoms wholly or partially of their electrons. Between this inner region and the visible surface of the photosphere the chemical elements recover most of their electrons, and we can observe their luminous vapors at various levels in the solar atmosphere under a wide range of conditions, which throw much light on the nature of matter. Thus the establishment of the fundamental principles of spectrum analysis, the discovery of the important element helium, and the first clue (through Lockyer's detection of the "enhanced" lines) to the modern theory of the constitution of matter, are all results of solar research. For other illustrations I must refer the reader to my Franklin Institute paper.

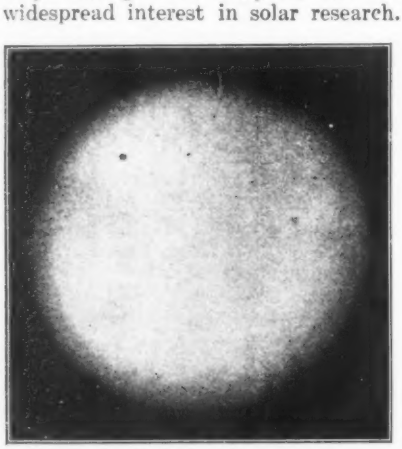


THE CALCIUM FLOCCULI

Photographed with the calcium line K, September 27, 1926. Compare this with the illustration below. Note same sun-spots.

All of the solar phenomena I have mentioned are easily within the reach of the amateur. If lucky enough to have access to a small machine shop, he can build his own instruments and most of the optical parts. If not, he may purchase his entire equipment at moderate cost or buy only the optical parts and employ a local machinist to do any of the machine work that is beyond his own capacity.

The classic discovery of Janssen and Lockyer in 1868, which made possible daily observation, in full sunlight, of the prominences previously visible only during total eclipses, aroused widespread interest in solar research.



DIRECT PHOTOGRAPH OF SUN

Taken in mixed light of all available lines, September 27, 1926, at Mount Wilson

Fascinated by this advance, and dimly conscious of the boundless other possibilities of the spectroscope, I began solar work as a boy in 1883.

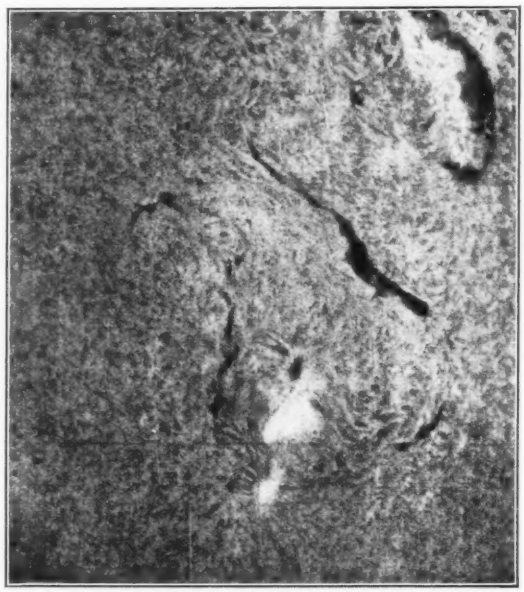
Six years later it occurred to me (as it had occurred to others) that by building up an image of the prominences upon a sensitive plate with the light of hydrogen or of calcium, I might photograph them without an eclipse. This I succeeded later in doing with a spectroscope, provided with a second slit instead of an eyepiece, through which a hydrogen or calcium line passed to the plate. When the slit of the spectroscope was moved slowly across the Sun, a complete image of all the prominences was built up on the plate by countless adjoining images of the narrow second slit. The bright light of the disk was excluded by a circular metal screen, and the encircling prominences were shown as distinctly as in photographs of total solar eclipses.

The next logical move (in 1892) was to try the same scheme for photographing the disk, where the calcium lines (H and K in the extreme violet) were known to be bright in many places. The spectroheliograph, as I had named the instrument, at once disclosed large bright clouds of calcium vapor (flocculi) in the solar atmosphere, which have since been extensively investigated by Evershed, Deslandres, St. John, and others. These bright flocculi lie at a low level, and do not project above the Sun's edge (limb) as prominences. Later, at the Yerkes Observatory, we found it possible to photograph the prominences projected against the disk as dark flocculi. They are generally dark because the hydrogen or calcium gas is comparatively cool at high levels, and thus absorbs the light from the hotter region below. The same plates also show the bright (hotter) gases at lower levels.

IN 1908 the Sun's disk was first photographed at Mount Wilson with the red hydrogen line Hα, and great vortices or cyclonic storms were discovered in the upper hydrogen atmosphere. These were found to center over sun-spots, and soon led to the detection with the spectroscope of strong magnetic fields in all spots.

This brief reference to the photographic registration of the chief phenomena of the solar atmosphere is necessary to a comprehension of the new work of the spectrohelioscope. The reader who is interested in the details should consult the original papers and also the many publications of Deslandres, Evershed, St. John, and others, who have made many discoveries and important contributions in this field of research. Most of these papers may be found in the journals *Astronomy and Astrophysics*, *Astrophysical Journal*, *Comptes Rendus* of the Paris Academy of Sciences, *Monthly Notices* of the Royal Astronomical Society, and in the publications of the Meudon, Kodaikanal, Yerkes, and Mount Wilson Observatories, available in the large libraries.

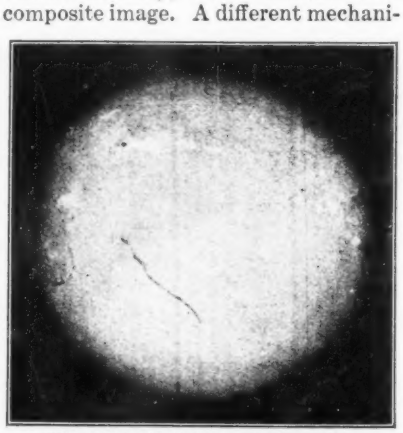
Our daily series of photographs of the solar atmosphere, begun at the Kenwood Observatory in 1891 and continued later at the Yerkes and Mount Wilson Observatories, contain many thousands of plates of the prominences and flocculi. Familiarity with these results has served to enhance my enthusiasm for the new possibilities recently opened by the spectrohelioscope.



BRIGHT AND DARK HYDROGEN FLOCCULI

These were photographed with the red hydrogen line Hα, September 9, 1915, at Mount Wilson Observatory

The spectroheliograph, as already stated, builds up its monochromatic image gradually, slit-width by slit-width, as the slit moves slowly across the Sun. The photographic plate, as it were, thus "sees" at any instant only a narrow strip across the solar image two or three thousandths of an inch wide, which it faithfully records, in its varied intensity, as an element in a composite image. A different mechani-

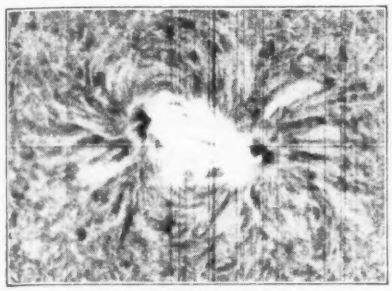


THE HYDROGEN FLOCCULI

Photographed with red hydrogen line Hα, September 27, 1926. Compare with nearly simultaneous photographs, "Direct Photograph of Sun," and "The Calcium Flocculi"

cal arrangement permits the same idea to be employed in revealing a large area of the hydrogen atmosphere directly to the eye. It is only necessary to utilize the well-known principle of the persistence of vision.

The first slit of the spectroscope, on which the Sun's image is formed, and the second slit, on which the red hydrogen line falls, are so connected that when the first slit moves, the second slit also moves in such a direction and at such a rate as to remain exactly upon the displaced hydrogen line. Then, if the slits are rapidly oscillated to and fro across a portion of the solar image, this



COMPLEX HYDROGEN WHIRLS
These were associated with a large bipolar sunspot, August 29, 1924. (Mount Wilson)

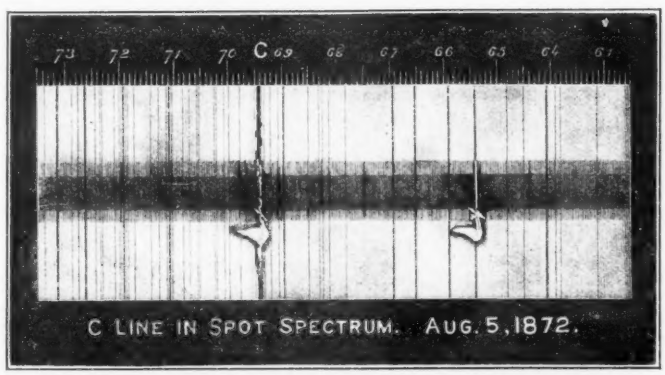
region will be seen in hydrogen light through an eyepiece focused on the second slit.

It is astonishing how this simple method, which was tried (but discarded) by Young in 1870 for observing the prominences at the limb, seems suddenly to bring to life the flocculi on the disk, which appear fixed and inert on photographic plates. There are several reasons for this. As the photographer using a spectroheliograph cannot see what is happening, he makes his exposures in a routine way and thus almost invariably fails to catch the successive phases of remarkable short-lived phenomena that often afford marvelous spectacles to the visual observer, who can pick out at a glance the most interesting and most active regions. Thus I have repeatedly seen with the spectrohelioscope the swift flow toward sunspots of masses of hydrogen larger than the Earth, adequately recorded only once with the spectroheliograph in a period of twenty years.

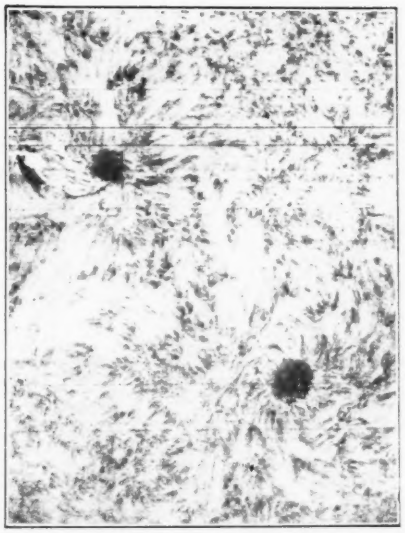
But the spectrohelioscope has another more important advantage, which permits the observer instantly to interpret phenomena missed altogether by the spectroheliograph, or so incompletely recorded that their interpretation remains obscure. This is due to the use of the "line-shifter," an adjustable plate of plane-parallel glass behind the oscillating second-slit, which permits the observer to set any part of the red hydrogen line or its wings on the slit during observation. In this way he can observe the form of the flocculus given by any part of the line, which is greatly distorted to the violet or red if the hydrogen is moving with high velocity toward or away from the Earth.

Lockyer and Young long ago saw and described the strange "motion forms" thus produced (shown in the illustration below). The bulge of the C (now called Hα) line toward the violet observed by Young on August 5, 1872, meant that the hydrogen gas at a point near an active sun-spot was approaching the Earth at a velocity of about 120 miles per second. Thus if a series of photographs of the Hα line is made, with the spectrograph slit stationary at many successive sections across such an eruption, the measured displacements of the line will give the radial velocity at the corresponding positions of the slit. This is the principle of Deslandres's "velocity spectrograph."

THE spectrohelioscope is far quicker in action and its results are instantly interpreted. Imagine an arch of hydrogen, representing the trajectory of masses of gas continually shooting along the same path near the middle of the Sun. Like a projectile, the gas moves rapidly upward, curves over and travels nearly parallel to the surface, and then falls, curving back toward the surface. Thus in the spectroscope the Hα line would appear twisted toward the violet at the point of eruption, less



RED HYDROGEN (C OR Hα) IN SUN-SPOT SPECTRUM
As observed by Young in 1872. The distortion is due to motion of the hydrogen in the line of sight of 120 miles per second. (From Young, "The Sun")



WHIRLS AND SUN-SPOTS
Counter-clockwise (N) and clockwise (S) hydrogen whirls associated with sun-spots in the northern and southern hemispheres of the Sun, September 9, 1908. Photograph made at Mount Wilson Observatory

and less displaced nearing the center of the arch (where the velocity in the direction of the Earth becomes zero), and increasingly displaced toward the red as the descending branch of the arch is approached. As the projection of such an arch against the surface usually appears curved, and as its form cannot be seen at all without a spectrohelioscope, the task of photographing the Hα line at several points along the arch, measuring its distortions at all these points on the photographs and interpreting the results would naturally take considerable time. Meanwhile the phenomenon may have passed through several stages and perhaps ceased altogether.

With the spectrohelioscope the whole analysis can often be completed in a few seconds. As the Hα line is moved across the oscillating slit, the darkest spot (maximum of intensity) of the arch is seen to move from its origin at the point of eruption (violet side of Hα) toward the center of the arch (center of Hα) and thence to the point of fall (red side of Hα). By reading the divided circle of the line-shifter at these points the corresponding radial velocities are obtained at once. Perhaps the most beautiful application of this method is in the measurement of the flow of hydrogen into the vortices centering in sun-spots.

IN the next issue Dr. Hale will describe the spectrohelioscope which the handy amateur astronomer may construct for a reasonable sum, using available blueprints, the cost being comparable with that of a fine radio set. Instructions for making the coelostat, eyepiece, and mirrors are contained in the book, "Amateur Telescope Making." A diffraction grating will be needed.—The Editor.

From the Scrap-book of Science

WHERE SCOTS HAE BLED

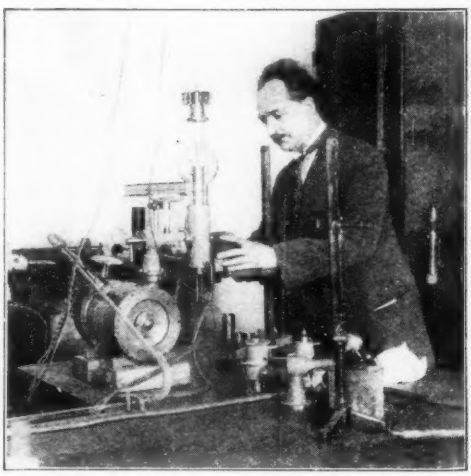
Work is nearing completion on a tunnel, 15 miles long and 15 feet in diameter, through Ben Nevis, located in Scotland, to connect with the pipe line shown here, the whole system being designed to carry water from Loch Trieg to a large power plant of the British Aluminum Company

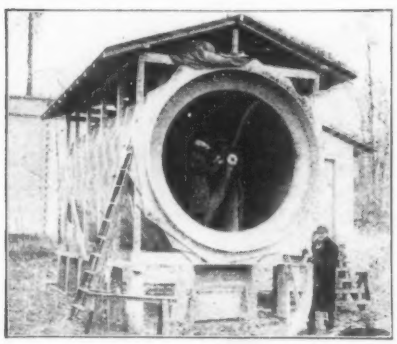
SCIENTISTS SMASH CROCKERY

Among the varied duties of the scientists in the Bureau of Standards in Washington is that of scientifically smashing dishes. In this illustration, A. N. Finn is shown using a testing machine which was developed by the Bureau to determine the strength of chinaware. The piece to be tested is mounted in the machine and a weighted pendulum is allowed to swing against it from gradually increasing heights along the curved scale until the dish shatters into fragments

GERM KILLER ➤

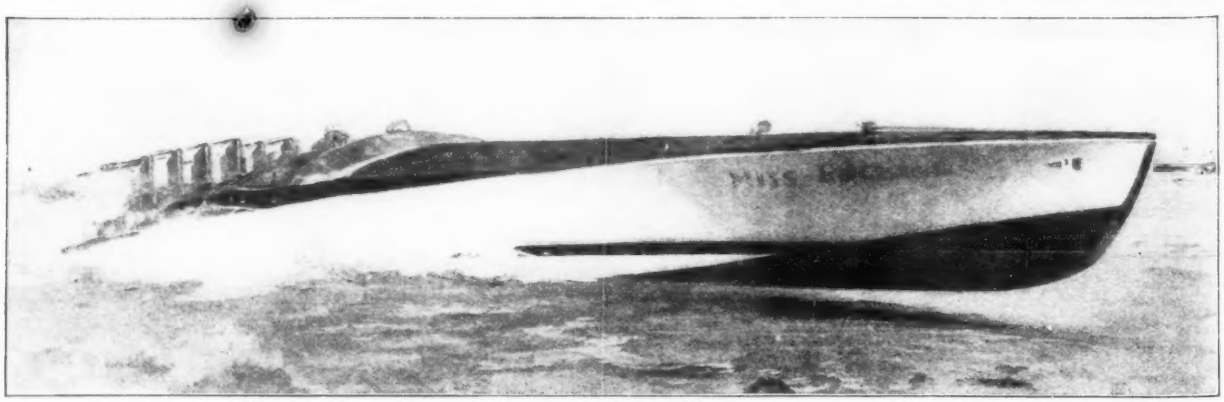
Dr. F. Holweck, Parisian X ray expert, with the apparatus he has developed to measure the energy, in the form of X rays, that is necessary to kill a single germ of the type that causes boils. He reports that this energy is equivalent to one millionth of the blow delivered by the smallest visible dust speck falling only one one-hundredth of an inch





➤ WIND TUNNEL

All kinds of flying conditions except snow and rain are provided by this tunnel at the Bureau of Standards, Washington, where model airplanes are tested. The wind-producing propeller is shown in its position



THE "WONDER BOAT"

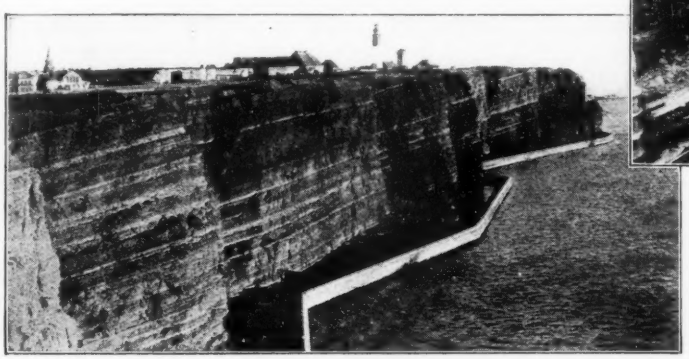
The 1000 horsepower motor boat, *Miss England*, which has been built to the order of Major H. O. D. Seagrave, the famous English racer, and with which he hopes to beat the present world's speed-boat record of 92 miles an hour held by an American. It is reported that it will be tried out at Miami, Florida, but this is not definite at time of writing

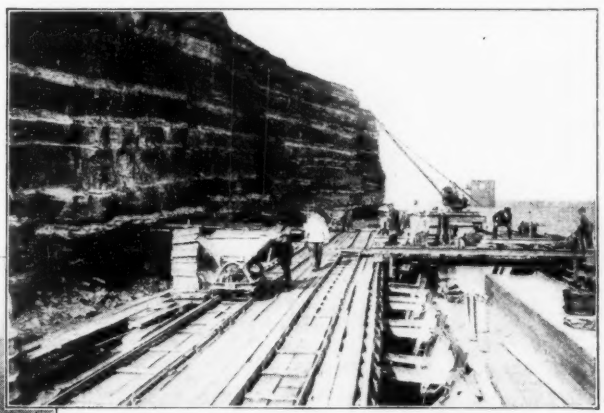
ONE OF THE LARGEST IN NORTH AMERICA

With a designed capacity of 272,000 horsepower in eight generators, this hydro-electric plant was recently placed in operation at Paugan, Quebec, Canada. The main dam is 917 feet long, 150 feet high, and creates a lake 30 miles long

HELP FOR "WHITE WINGS"

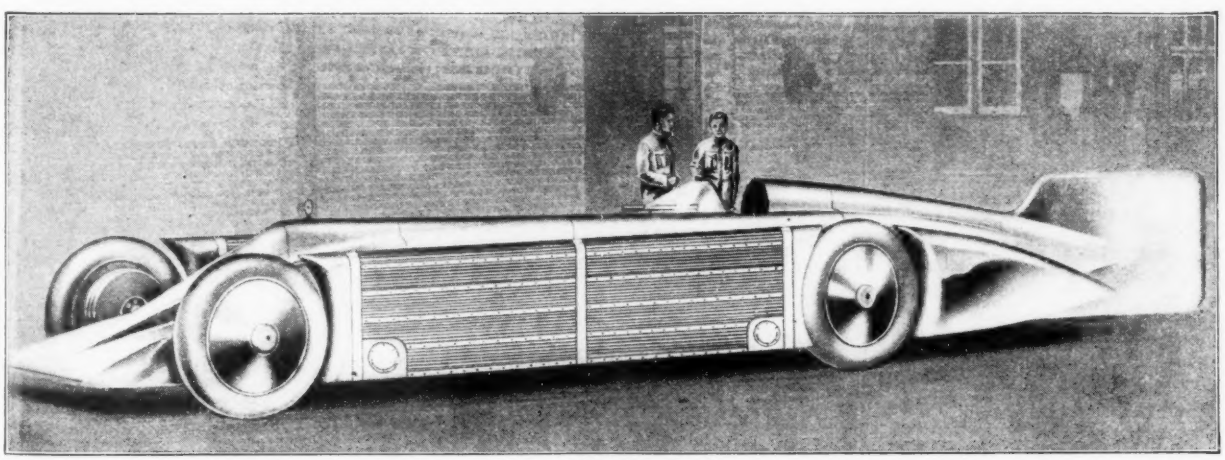
A mechanical assistant for street cleaners, this device was shown at the recent fair in Leipzig, Germany. Cogs and cams, operated from the axle of the wheels, speed up the rotating brush so that it does its work quickly and thoroughly





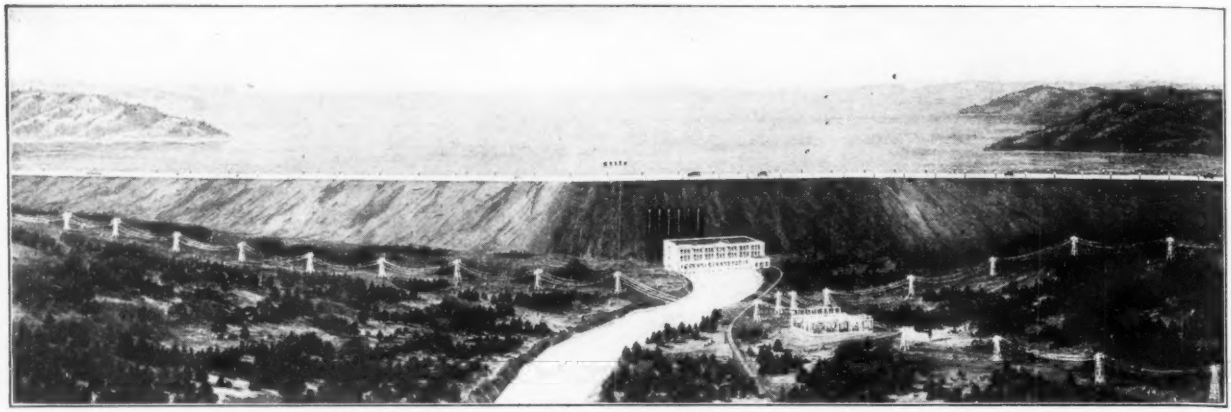
PROTECTING DEFENSELESS HELIGOLAND

North Sea storms threatened to crumble Heligoland, high, rocky island "Gibraltar" of pre-war Germany, and it was estimated that the island would disappear in 80 years. Photographs at the left and right show the concrete wall being built to prevent erosion by storms. A biological station is now on the island



THE "WONDER CAR"

Major H. O. D. Seagrave's recently completed 450 horsepower racing car, the *Golden Arrow*, which required a year to build. With this anomalous machine, Major Seagrave is confident that he can attain an average speed of 240 miles an hour, thus beating the present world's record by slightly over 32 miles an hour. Wind-tunnel tests were made on models of the new car and the final design embodies principles of aerodynamics—wind resistance, vacuums, upward thrust, and wheel suction—that are the result of long study. The engine of the *Golden Arrow* weighs almost 1000 pounds. At this writing, it is reported that the trials will be held on the world-famous automobile speedway at Daytona Beach



A MAN-MADE MOUNTAIN THAT IMPOUNDS A GREAT LAKE

An artist's conception of the dam and lake as they will appear when completed. This drawing visualizes the immensity of the work, the power house and transmission lines appearing small by comparison with the dam over the top of which a highway will be constructed

A Mountainous Earthen Dam

Gigantic Earth-fill Dam In South Carolina, One of the Largest In the World, Will Be a Part of Huge Hydro-electric Project

WHAT will be the largest earth dam in cubical content in the United States, is steadily rising to its mountainous proportions on the Saluda River, 10 miles from Columbia, South Carolina. This great dam is being built by the Lexington Water Power Company, subsidiary of the General Gas and Electric Corporation, New York, for hydro-electric development of 300,000 horsepower.

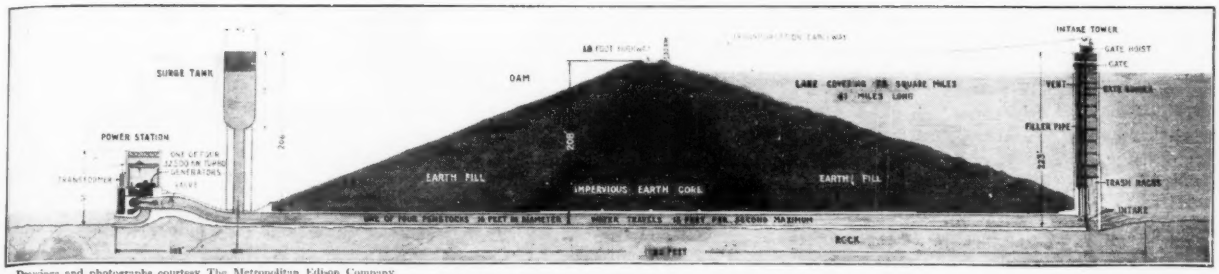
The dam will be 208 feet high, nearly a mile and a half long, and a quarter of a mile thick at its base. It will contain 11,000,000 cubic yards of earth fill and is now nearly one third completed. A concrete highway, part of the state highway system, will be built across the top of the dam.

The dam will create a lake 41 miles long and 14 miles wide at its widest point, with a shore line of 520 miles. It will cover 53,700 acres of land and, when filled, will contain 750 billion gallons of water—sufficient storage to keep the power station operating over a six months' period of complete drought.

The hydraulic fill system is being used in building the dam. Two separate loose earth dams have been built to a height of 75 feet, 1000 feet apart, across the valley. The area between the two fills will be pumped full of water to a depth of 25 to 30 feet, creating a segregation pool, which will be maintained by pumping in enough water to take care of evaporation and seepage. Streams from monitors pumping 750 gallons of water per minute at a velocity of 125 feet per second will be directed against the

UNDER THE DAM

The four 16-foot steel penstocks and the 48-foot concrete tunnel which were built on the dam's rock foundation and which will carry water from the intake towers above the dam to the power house below, being covered with earth



Drawings and photographs courtesy The Metropolitan Edison Company

CROSS-SECTIONAL VIEW OF THE DAM

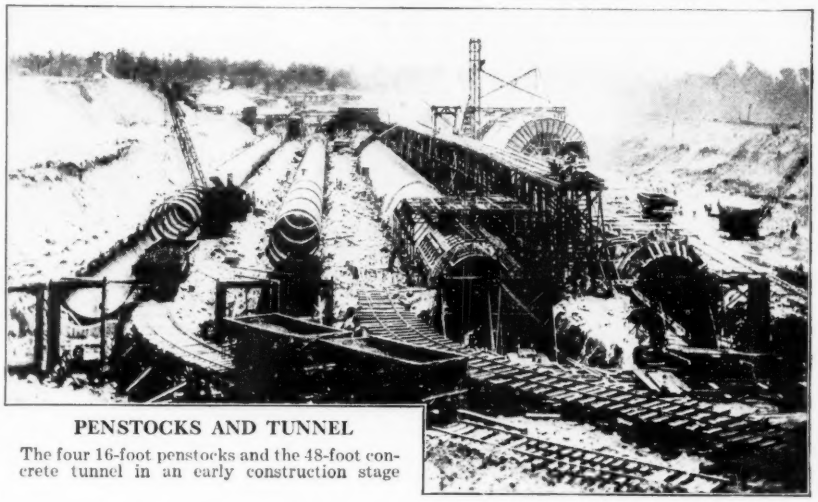
Drawing of a section of the dam at its highest point near the power house. The text tells how the impervious earth core is built up. Note dimensions of the dam, height of intake and surge tank towers, and relative size of the power house. Base of dam is 1150 feet thick

banks of these earth fills, thus washing down fine material into the pool, where it is deposited to form a core of densely compacted material, of which 65 percent will pass a 100-mesh screen.

As the pool is filled up, the outer earth fills will be raised by dumping additional loose earth. When within about 30 feet of the top, these sluicing operations will cease. The next 10 feet will be built by dumping selected materials into the pool. The last 20 feet will be built by consolidating selected materials by wetting or rolling.

Four 16-foot steel penstocks and a 48-foot concrete tunnel were built in solid rock foundation in the bed of the river before the earth fills were started. These connect with five intake towers, each 223 feet high, which will draw the waters from the lake through to the power station to operate the six 32,500 kilowatt generators to be installed.

In general, southern hydro-electric developments have relatively small storage. Thus their power out-put varies with stream flow and supplemental steam plants are made necessary. Saluda has sufficient storage to make a stand-by plant unnecessary.



PENSTOCKS AND TUNNEL

The four 16-foot penstocks and the 48-foot concrete tunnel in an early construction stage

The development was started in April, 1927, and it is expected to be completed in the fall of 1930. The builders are W. S. Barstow and Company, Inc., New York; Murray and Flood, New York, are the engineers; and A. S. Crane, New York, is consulting engineer. W. S. Barstow and Company, Inc., contracted with the Arundel Corporation of Baltimore for the construction of conduits and dam.

SEGREGATION POOL

Continuation of the panoramic view at the left. This shows part of the pool which is maintained for the purpose of settling fine material in the central part of the dam to form the impervious core. Compare with railroad for relative size

BEISAN FROM THE AIR

Here the University of Pennsylvania Museum has maintained an archeological field expedition for seven years. Beisan is the Biblical Beth-shan and is 90 miles north of Jerusalem. The modern Arab town is shown on left. The expedition house is in right upper corner

Exploring the Biblical Beth-shan

For Thousands of Years, Invading Armies Stormed This Little Hill at the Crossroads of Palestine

By CORNELIA H. DAM

Head Docent, The Museum of the University of Pennsylvania

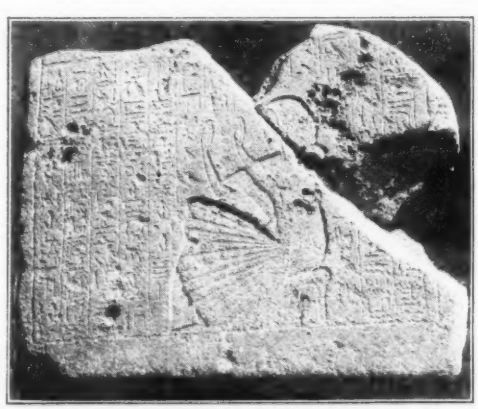
NINETY miles north of Jerusalem, where the Valley of Jezreel drops into that of the Jordan, stands the ancient stronghold of Beth-shan, the Scythopolis of the Greeks. Situated as it is at the crossroads of ancient highways from north to south and from east to west, it was from remote antiquity down to Crusader times the key to both military and commercial operations in northern Palestine. Inevitably, therefore, every invading people—Egyptian, Hittite, Philistine, Israelite, Persian, Roman, Byzantine, Arab, and Crusader—stormed this little hill in the military campaigns that beat incessantly against the city walls of Palestine throughout her history. Each succeeding people left behind material traces of its occupation of the town, buried in the debris of battle and decay, awaiting the time when the spade of the archeologist should uncover them to help him tell the story of man's past.

ENCOURAGED by the knowledge of the town's eventful history, braving pestilential heat and the worst malarial belt of Palestine, an expedition maintained by the Museum of the University of Pennsylvania has been at work upon the "tell" of Beth-shan for seven seasons, with results that have been generally acclaimed by archeologists as the most important in that country for many years.

Overshadowing other discoveries on the site, in historical importance and in general interest, has been that of a series of temples which, each built upon the ruins of the last, crowned the citadel successively from 1500 B.C. until medieval times.

Beneath the medieval, Byzantine, and Gracco-Roman remains, the third level reached belonged to the Philistine-Israelite era, and revealed the two Philistine temples mentioned in the story of Saul and David, the "Temple of Dagon" and the "House of Ashtaroth." (I. *Samuel*, xxxi., 10; I. *Chronicles*, x., 10.)

Brave King Saul defied the warlike hosts of the Philistines and with his little army went down to heroic defeat before them on the slopes of Mount Gilboa.



EGYPTIAN STELE

Dedicated in the temple of Dagon by a local Egyptian official, Amen-em-Apt. See the text on page 313

"And it came to pass on the morrow, when the Philistines came to strip the slain, that they found Saul and his three sons fallen in Mount Gilboa.

"And they cut off his head, and stripped off his armour. . . And they put his armour in the house of Ashtaroth: and they fastened his body to the wall of Beth-shan."

The account in I. *Chronicles* says "They put his armour in the house of their gods, and fastened his head in the temple of Dagon."

News of the national calamity was brought to David while he was in camp in Ziklaq, and the

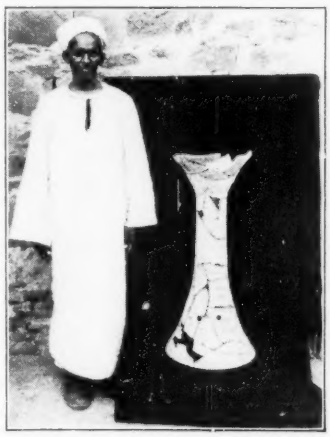
young poet-warrior sallied forth to wreak vengeance upon his arch enemies, the Philistines. He captured their citadel of Beth-shan and destroyed it—how thoroughly could be read in the excavations, where mud brick walls had been baked red by the heat of the conflagration and charred and fallen timbers filled the rooms to a depth of three feet.

Both the temple of Ashtoreth and the temple of Dagon showed in their plans and general character a strong Egyptian stamp, having been built during the reign of Rameses the Great, about 1283 B.C., when that warlike Pharaoh was using the town as a military post from which to operate throughout his Syrian empire.

THE two temples, built side by side and separated only by a corridor, occupied the southern slope of the citadel, just within the fortification walls. The smaller and northern one was identified as the "house of Ashtaroth," the larger and southern one as the temple of the Canaanite god, Resheph, the Dagon of the Philistines. Both had plastered walls of mud brick, floors of beaten earth, and roofs of wood. Windows, if there were any, must have been simply narrow slits high in the wall, such as are found in various Egyptian buildings of the same period.

In the center of the rectangular hall, about 54 feet long and 30 feet wide, which appeared to be the main feature of the temple of Ashtoreth, had once stood four columns of which the basalt bases alone remained. Near one of them was found part of an Egyptian stele dedicated to the goddess Antit (Ashtoreth) who is here depicted wearing a long white robe and, on her head, a plumed crown. Above her is written, "Antit, queen of heaven, mistress of all the gods."

The temple of Resheph or Dagon was larger and somewhat more elaborate in plan than that of Ashtoreth. The great central hall, 73 feet long and 26 feet wide, was divided into three aisles by a double row of columns, three on each side. Beneath the stone base of the central column on either side was found a foundation deposit, on one side of gold and silver, on the other of silver, consisting of rings, bracelets, earrings, wire, and nuggets of the metal. The altar, which probably stood at the eastern end of the hall, was destroyed by a Byzantine reservoir which later was sunk through that end of the temple.



HOLLOW TEMPLE OBJECT

This is a hollow cult object of pottery from the temple of Mekal. It is probable that incense was burned in it. Note holes near base

In this temple too was found a contemporary representation of the deity to whom the building was dedicated. It is a beautifully cut cylinder-seal of Rameses the Great, showing the Pharaoh wearing his war helmet, shooting arrows at two captives who are tied up before a Canaanite fort-standard. Facing the king is the Canaanite war-god Resheph wearing a conical crown with the head of a gazelle attached to it. In his left hand he holds a scimitar and in his right the ankh-sign; that is, he holds in his two hands life and death.

But the most extraordinary and interesting of discoveries in this temple was that of an inscribed stone doorjamb which gives us the name, titles, and a portrait of the actual builder of the temple, so that now for the first time in the history of excavation we have the name and portrait of the builder of one of the Canaanite temples mentioned in the Bible. He was Rameses-Wesr-Khepesh, and his portrait represents him in Egyptian headdress and a voluminous linen robe, his hands raised in adoration, presumably to Resheph. His titles read "Overseer of soldiers, commander of the bowmen of the Lord of the Two Lands (i.e., Pharaoh), royal scribe, great steward, Rameses-Wesr-Khepesh, the son of the fan-bearer at the right hand of the king, chief of the bowmen, overseer of foreign countries, Thothmes." He must have been a noble of considerable position temporarily in charge of the military post at Beth-shan.

Most important evidence as to the nature of the cult of Ashtoreth and the rituals of her worship at this period comes from the various cult objects which were found in the storerooms of Dagon's temple and in the temple of Ashtoreth itself. Along with fragments of vases, lamps, bowls, and tools of bronze were found certain curious objects of pottery which may be divided into four main classes: (1) Cylindrical stands, (2) Shrine-houses, (3) Sacred "boxes," and (4) *Kernoi* or hollow rings with small cups or vases attached at intervals, a type of sacred object common among the Aegean people.

CLEARING THE CANAANITE FORT TOWER

The fort tower was found in a level dating from 1411 to 1314 B.C. The drums are from a later Hellenistic-Roman temple, the foundations of which had cut through into the earlier levels

THE cylindrical stands resemble tall vases open at both top and bottom, decorated with serpents and doves in low relief, or painted with geometric designs, gazelles, or sacred trees, all symbols of Ashtoreth. Mr. Alan Rowe, director of the expedition, after making a thorough study of similar objects represented in ancient Babylonian art, concludes that they were undoubtedly used in sacred rites associated with agriculture and were, in fact, but types of the famous "Gardens of Adonis" of classical writers. These "gardens" were pottery vessels or baskets filled with earth in which plants were forced by frequent watering and exposure to the sun, a rite of sympathetic magic to promote the renewal and growth of vegetation through the aid of an agricultural deity.

Directly below the temple to Dagon, or Resheph, of Rameses II., was uncovered one built by his great predecessor, Seti I. about 1300 B.C. It dif-

fered somewhat from the later temple in plan, having an entrance court outside the main hall which here was apparently roofed over only at the northern end, the southern being left open to the sky. Behind a great altar at the northern end, and up a low flight of steps was a little upper altar room, the floor and probably the walls of which were painted bright blue, the color of heaven.

A GOLD PENDANT ➤

The illustration shows the goddess Ashtoreth with headdress and sceptre. The modeling of the figure, while archaic, shows considerable artistic feeling in its execution

Quantities of flour found near some brick ovens in one of the rooms near the temple suggested offerings that were made to the goddess, as did the jars filled with sesame seed which probably in ancient times, just as today in Palestine, was used for making oil, for sweets, and for sprinkling upon biscuits. "Seest thou not," cried Jeremiah, "what they do in the cities of Judah and in the streets of Jerusalem? The children gather wood, and the fathers kindle the fire, and the women knead their dough, to make cakes to the queen of heaven. . . ." (Jer. vii.: 17-18).

The remains of the Seti I. temple having been surveyed, planned, and mapped, were then removed to uncover those of a similar, still earlier, fourth temple, which evidently belonged to the reign of Amenophis III., about 1400 B.C. Figurines of Ashtoreth again identified the deity to whom it had been dedicated. The size and plan of this temple were almost identical with those of the Seti temple, the latter having evidently been a rebuilding of the earlier one.

AMONG the objects which were found in this temple several were of first importance to archeology: from a foundation deposit below the altar steps cylinder seals and a faience fingerring of Amenophis III. helped to identify the builder of the temple, while a fine Syrian dagger of bronze, a magnificent Hittite axe-head in the shape of a hand outstretched (the best one of its kind ever discovered), and a basalt model throne and model altar, both of typical Cretan design, testified to the cosmopolitan character of the population of Beth-shan 3300 years ago and to the number of nations over which Ashtoreth even then held sway.

For the scientific world, however, by far the most important discoveries were those of last season, when, at a depth of 50 feet below the top of the tell, and in the stratum directly below those of the other temples, were found the earliest Canaanite sanctuaries which have yet been discovered in Palestine.

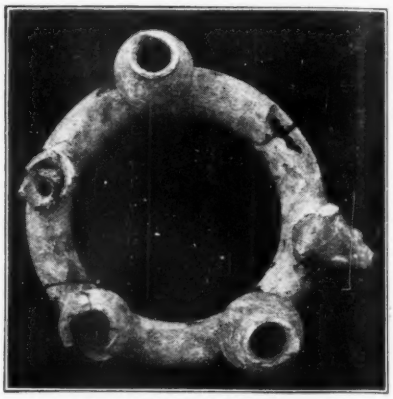
These two, which bring the number of Canaanite temples excavated at Beth-shan up to six, although they belong to the reign of Thothmes III., about 1500 B.C., unlike the later temples, have no connection with any Egyptian archetypes, and are wholly Canaanite in origin. The larger and southern one was dedicated to the god of Beth-shan, the smaller and northern one to the goddess.

From an outer court in the southern temple the visitor passes to an inner court where stand three low brick tables for offerings, upon which were probably placed those portions of meat offering which were not offered up in the inner sanctuary.

JUST to the south of them, Mr. Rowe found the socket for a perpendicular pole upon which the carcass of the sacrificed animal was dressed, while near by were lying a sacrificial dagger of bronze, the shoulder blade of a young bullock, and a huge bronze pendant, evidently one of the ornaments with which the live bull was decked for sacrifice.

Turning southward and passing by the offering tables and the pole upon which the sacrificial carcase hung, the visitor enters a large corridor which runs across the southern end of the temple and turning north again opens on the eastern side into a room which proved to be of the greatest interest, for it contains the *mazzebah* or sacred stone emblematic of a Canaanite divinity. It is a roughly hewn cone-shaped block of basalt set upon a stone foundation of the same material. The floor around it is of brick, not earth as in the rest of the temple, and sunk in this floor just in front of the column is a basalt libation cup to collect the blood offerings that drained off the column.

The rooms and corridors so far described constituted that part of the temple to which the laity was admitted. Beyond them, filling the northwestern and larger part of the sacred area are two rooms, the inner sanctuary and, south of it, adjoining, the room of sacrifice. These were reserved for the priests.



HOLLOW POTTERY RING

Kernos, or sacred object consisting of ring and five cups or vases. Use uncertain, but possibly intended for flowers. See text

The room of sacrifice was easily identified by the great brick altar on the northern wall which separates this room from the sanctuary. The altar itself was so placed that it could be approached from either room. On top of the altar is an L-shaped channel, by which the blood of sacrifice was conducted to an outlet in the side of the

CONICAL EMBLEM OF DEITY

It is the "mazzebah," or sacred conical stone which was emblematic of a Canaanite deity, as it appeared at the eastern end of the great corridor of the temple of Mekal

altar. In one side of the channel is a hole for a wooden peg by which the victim was tethered on the altar. Nearby were lying the horns of a young bull, doubtless the last one that was sacrificed in the temple and the same one whose shoulder blade was found in the outer court.

The main feature of the inner sanctuary is the central altar, which was approached by three steps on its southern side. On a low wall which projects from it on the right is a shallow bowl for blood offerings. The cooked meat offerings were probably placed on a smaller low stone altar which stood a few feet in front of the steps of the main altar. The main altar was most likely once adorned with the various offerings and sacred objects which were found lying around it.

THE offerings of jewelry include a magnificent amethyst scarab of Sesostris I., 1950 B.C., which is so far as we know the only one of its kind in existence. The cult objects are a pottery figurine of Ashtoreth, a model altar of Cretan design, a gold-covered figurine of a god, a cylindrical stand like those already described from the other temples, and, most decorative of all the cult objects yet discovered, two fine painted pottery vases.

Fragments of plaster found here and there suggest that the walls and floor of the temple may have been painted the "blue of heaven" as was the upper altar room in the Seti temple; we cannot be sure. But it does seem certain that the outward appearance of these earliest temples was not like that of the solid walled and roofed temples of the later period, for on the low walls of both of Thothmes' temples were small brick pedestals which seem to have been for the purpose of holding the supporting posts of a board or wicker enclosure that was open to the sky.

A SHORT RAIL SECTION HELPS

A small section of contractor's rail serves to lighten the labors of the Arab workmen. They are removing one of the Byzantine columns carefully protected for shipment to the Museum

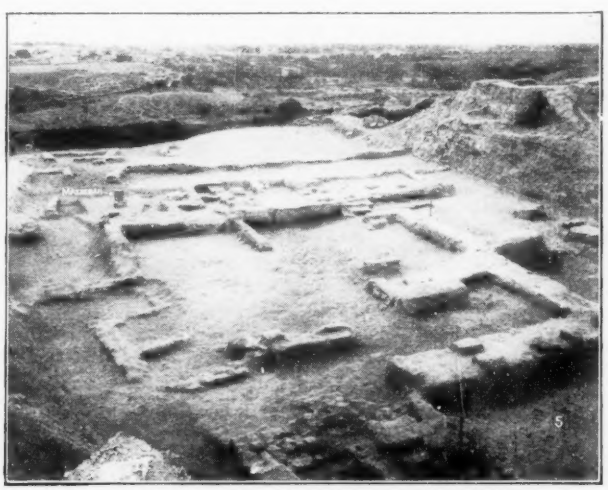
In some debris near the *mazzebah* room was found the inscription which gives us the name of the god of the temple, a new god in the Pantheon of the East. It is on a little Egyptian stele which probably once stood near the *mazzebah* and is dedicated to "Mekal (or Mekar) the god of Beth-shan," by a builder named Amen-em-Apt, and made by his son, Pa-Ra-em-Heb. Mekal's picture and name appear here for the first time in history.

The northern temple on the Thothmes III. level, which is not yet entirely cleared, seems to be very like the uppermost "House of Ashtaroth" which was found in the Rameses II. level and must have been dedicated to the female counterpart of Mekal, some early form of Ashtoreth. Various serpent cult objects indicate that the center of a great Palestinian serpent cult was once located at Beth-shan and that even the traditional name of the city, Beth-shan, or "House of Shan" may be derived from that of the old Sumerian serpent deity Shahan or Shakhan, who may, therefore, have been the original deity worshipped in this city.

What this season's dig may reveal, when the temple areas shall have been completely cleared, is a matter of anxious conjecture on the part of all who are following the story of the expedition, for the importance of the discoveries made heretofore in the upper levels makes us confident that at the early level now reached we may find considerable material entirely new to Palestinian archeology and to the history of religion.

NORTHERN PORTION OF SOUTHERN TEMPLE

The northern temple is seen partly excavated and is marked "N T." "1" is the inner sanctuary, "Mekal Temple," "6" is the corridor leading to northern temple, and "7," the outer entrance court



CENTRAL AND SOUTHERN PORTIONS

"1" is the room of inner sanctuary, "2," altar of sacrifice, "3," corridor leading to "mazzebah" room, "4," entrance court with three offering tables, and "5," room north of the inner sanctuary

Boston's New "Madison Square Garden"

How a Railway Station and an Auditorium Were Combined to Double the Use of Land

BOSTON'S NEW NORTH STATION AND "GARDEN"

In Boston's congested "North End" a new railway station was imperative, so a double-function edifice was erected combining all the features of a great terminal, with amusement center atop. The plan was conceived by the Boston and Maine Railroad

THE romance of engineering has many facets. A bridge, a tunnel, a skyscraper may be filled with romance but when we have romance and history; a station and a sports arena superimposed; all combined we have a most interesting proposition. The new "North Station" of the Boston and Maine Railroad in Boston has just been completed and we are able to give our readers a few salient facts.

Reference to old 18th Century maps shows that a considerable body of water was impounded at the south end back of Beacon Hill to supply power for a water mill. To raise the level a causeway was built to separate the 70 acre millpond from the Charles River. This causeway was built of masonry. In time the mill pond was filled up to the causeway, which then became a transitory boundary. Then came the railroads and Causeway Street at the water's edge was the natural location for the terminal stations of the Lowell, Fitchburg, Eastern, and Boston and Maine Railroads crossing the Charles River by bridges. There were originally three stations, not connected in any way.

IN 1894 the old North Station was built which was in use until the fall of 1928. When the new station was decided upon, naturally the old location afforded the most logical and economical site, so the problem was to take care of the large body of commuters, as well as passengers for long hauls without disturbing traffic conditions. Other roads than the Boston and Maine had met the problem, but never before, it is stated, had such construction speed been attained under similar conditions.

The traffic had become so great that the old North Station was totally inadequate, but there was no room to transfer this traffic to another location, therefore the work had to be done as far as possible without disturbing the regular flow of railroad travel, and it may be stated as a fact that not a passenger was injured or a train delayed during this large building operation. It naturally required great executive control to co-ordinate all of the work of construction with a view to efficiency and safety.

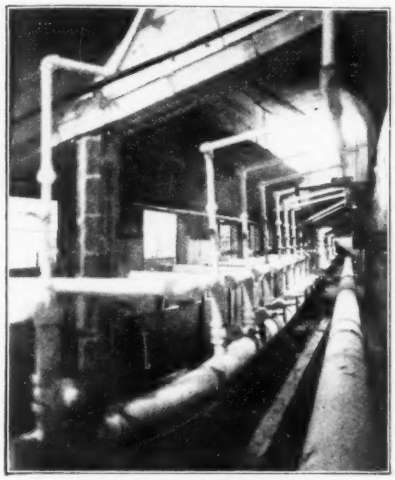
CONSTRUCTION was made doubly difficult on account of the tons of stone of the old wharves and also because the piles of the old station could not be removed. The contractors drove new concrete piles without disturbance to the old wood piles and thus secured the proper footings for the double-use building. The architects were Funk and Wilcox Company, and Fellheimer and Wagner, associate architects. The designing engineers who also did the construction work were Dwight P. Robinson and Company, Inc. The first foundation work was commenced on December 5, 1927. The railroad ticket offices and station passageways were opened on September 1, 1928. The station was formally opened on November 14, and the "Garden" November 17. The station tracks were laid in their former location except for slight relocations to permit the in-

ROOF OF THE STATION

On April 30, 1928, the roof of the station was practically finished so that the arena could be started. The formal dedication of the huge building took place on November 17, 1928

stallation of baggage ramps between pairs of tracks to the mezzanine floor.

The ground floor and mezzanine floor are devoted entirely to railroad station purposes. The concourse is 62 feet wide and 400 feet long, extending across the railheads of 23 tracks. There are many offices and stores in the structure which help to sustain the financial burden. The structure rests on 1518 concrete piles. The ground area of the station, including entrance, is 100,000 square feet. The exterior

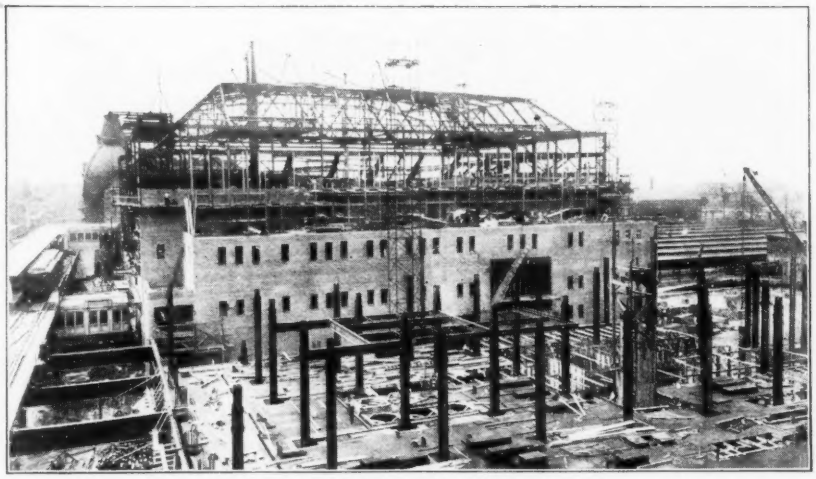


THE BRINE PIPE LINES

Brine is brought from 1000 feet away and circulates through 13 miles of piping

of the building is designed in a modern style of architecture, a large pylon at each end marking the entrance, between which there are seven arched openings.

The financial burden of the terminal was solved by a brilliant plan of erecting a sports arena as a part of the station building, so that one tract of land does the work of two. On the roof of the station is erected the arena measuring 110 by 245 feet, which is enclosed by a coliseum building 204 by



THE "GARDEN" CONSTRUCTION

Here we have the arena in the making. The clear span of the roof trusses is 175 feet. Photograph shows the condition of August first. First use of arena, November 17, 1928

360 feet. The ground height from the arena floor to the roof truss is 67 feet.

The reason for a "Madison Square Garden" at this particular point seems very logical. It is at a terminus serving a vast section of heavily populated New England. It is also within walking distance of the principal business district and is served by a splendid subway and trolley system. It is very convenient on a winter's night to enter, without leaving the building, a warm coach to take you to Lawrence, Webster, Lowell, or Gloucester, or the subway to Cambridge.

A LOCATION for a place of amusement involving large bodies of spectators could hardly be improved upon. Access to the arena is obtained by exceedingly well designed ramps which would empty the structure in a few minutes. The seating capacity is 18,000 for boxing and 14,500 for hockey. The lighting is so good that photographs have been made with the normal illumination. Great attention has been paid to ventilation so that tobacco smoke can be instantly removed. A new product of vegetable fiber was used to cover the entire ceiling, with the result that the arena has wonderful acoustic properties. Even concerts can be held here.

The coliseum is called "Boston Garden" and the same kind of events take place as in the sister arena in New York. The floor can be flooded and frozen for skating and games of hockey. There is no danger of possible injury from any accident to the refrigerating machinery for the fluid for freezing is brought into the plant from an adjacent refrigerating plant. The ice floor contains 13 miles of 1½ inch pipe.

In general, the mechanical equipment for this coliseum has been planned to meet every known condition in connection with sports and various other assemblies, and the servicing of the plant has been carried out to a degree in excess of any similar project in the world.

Copyright by Dwight P. Robinson & Co.

THE GARDEN IS DEDICATED

A big boxing carnival opened the edifice on Nov. 17, 1928. It seats 18,000 for boxing. The lighting and the acoustics are fine

THE FIRST HOCKEY GAME

Three days after the dedication the first hockey game was held, "Bruins *vs* Canadiens." The arena seats 14,500 for hockey

Quantitative Analysis of the Sun

The Ordinary Identification of the Chemical Elements on the Sun by Means of the Spectroscope Has Long Been Possible. The Newest Development Is Quantitative Analysis of These Same Elements

By HENRY NORRIS RUSSELL, Ph.D.

Head of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

ONE of the memorable moments in the experience of the amateur astronomer—if he has a real love of science—is his first adequate view of the solar spectrum. Even with the small spectroscopes which may be found in any laboratory of chemistry and physics the spectrum is a beautiful object, a brilliant band of light glowing with colors whose purity and intensity of hue cannot be matched elsewhere, and crossed by innumerable dark lines.

To the novice, the colors are likely to be the most impressive feature. The astrophysicist pays no more attention to them "than does the geographer to the colors on a map," as Prof. Young put it many years ago; for the lines themselves tell us a story so long and wonderful that many chapters of it have not yet been read.

Everyone knows some chapters of this story. The positions of the lines, for example, are characteristic of the chemical nature of the material which absorbs them. Every element in the Sun's atmosphere and every chemical component which can exist without decomposition there, in spite of the high temperature, has its own distinctive set of wavelengths for its lines; and so a very extensive qualitative analysis of the Sun's atmosphere is possible.

IN the revision of Rowland's Table of the Solar Spectrum, which has recently been published from Mount Wilson, no less than 57 of the elements have been identified by means of the spectrum lines.

Such an analysis by no means exhausts the possibilities of the study of spectrum line positions. Minute shifts of the lines are caused by motion in the line of sight, and it is an old story how these have led to the discovery of hundreds of double stars too close to be resolved by any telescope; also to fundamentally important determinations of the rate of motion of the Sun and the stars in space. Still other small shifts and doublings of the lines reveal the existence of powerful magnetic fields in sunspots, and of a weaker one surrounding the whole of the Sun's surface. And yet another shift in the spectrum of the faint Companion of Sirius has provided one of the most convincing proofs of Einstein's theory of general relativity.

With the wealth of attractive possibilities for investigation it is no wonder that astrophysicists have busied themselves for years with the precise measurement of the positions of the lines, both in laboratory spectra and in those of the stars.

The spectra, however, reveal more than such measure can detect. The *strength* of the lines has its own story to tell. In a general way this has long been recognized, and such elements as calcium, iron, and magnesium, which show very strong lines in the Sun, must clearly be abundant constituents of its atmosphere. Many of the elements which on earth are "chemical curiosities," such as gallium, germanium, and indium, show such feeble solar lines as to make it evident that they are rare on the Sun also.

THE passage from these rough qualitative statements to a real quantitative analysis of the atmospheres of the Sun and the stars is a matter of our own times. Within the last decade the advance of atomic theory has given us a clear understanding of the origin of the spectral lines upon which we have worked so long. The words "clear understanding" may sound strange when it is remembered that we are still very much in the dark as to the real nature of the atom—whether it consists of electrons, circulating in orbits, as now seems doubtful, or of electricity distributed in a more generalized fashion determined by the new "wave mechanics," or what not.

Fortunately for the student of the stars, the advance of our knowledge in many important fields does not depend on the solution of these recondite problems. We know enough already to say with confidence whether a spectral line arises from a neutral or an ionized atom; also how much energy has to be loaded into the atom to get it into a position to absorb the given line or to limit it. And we can calculate pretty securely what fraction of the atoms of a given element in an atmosphere of given temperature and pressure will be in any given one of the various possible states. Recognition of these facts has brought order out of chaos and shown how the widely different types of stellar spectra arise, not from differences in the chemical composition of the stars but from the different degrees of excitation of the atoms of different temperatures. In all this work the intensity of the lines is our main observational guide.

Until very recently we knew little or nothing about the actual number of atoms which were required to produce a spectral line of a given strength, but this too can be calculated, and the results are of much interest. It appears that when the number of atoms which are ready to absorb the given line increases, the strength of the line increases too; but only in proportion to the square root of the number of atoms at work. A line ten times wider than another will cut out just about ten times as much light from the solar spectrum, and may fairly be called ten times stronger. But it will require a hundred times as many atoms to produce it.

THE theory shows, too, that a spectral line should not be a sharp black band, but should decrease gradually in darkness from the center outward, fading into the continuous spectrum gradually. This agrees with the facts. The stronger lines of the solar spectrum are conspicuously "winged" by borders of gradually fading intensity. Ordinary photographs do not show this very clearly because they are taken for the purpose of measurement of the *position* of the lines; and the exposure, contrast of the plate, development and so on, are all chosen so as to get as "hard" a picture as possible and emphasize the darker center of the line.

When photographic processes that are adapted to reveal, rather than conceal, the real graduation of intensity are employed; when the plates are measured with the microphotometer which records accurately the opacity of the negative at each successive point near the line; and when the proper calibration is made to find from these measures the true intensity of the spectrum,

it is found that even the narrower spectral lines have wings extending for several times their apparent width on ordinary photographs, while for the stronger ones these are very wide. For the familiar *D* lines of sodium, for example, the width across the wings is more than half the interval between the lines, and the great *H* and *K* lines of calcium in the violet actually run together.

From the curves which show how the intensity falls off in these wings at different distances from the center of the lines, it is possible to calculate the actual numbers of atoms which are at work in producing the line. Some very interesting work of this sort was done last year by Dr. Unsöld, a young German physicist at the Einstein Tower at Potsdam which was designed for solar observations. According to the quantum theory of spectra (confirmed fully by observations) just twice as many calcium atoms should be concerned in the absorption of the *K* line as act to produce the *H* line. The measured widths of these lines are in the ratio of 1.4 to 1; that is, proportional to the square roots of the number of atoms at work, as they should be. The same thing happens for the sodium lines, for the aluminum lines in the violet, and in other cases; affording a good test of the theory.

FROM these measures Dr. Unsöld finds that the number of sodium atoms which are at work on the *D* line is 2.6×10^{16} (or 26,000 million millions) above each square centimeter of the sun's surface. For the aluminum lines the number is 7×10^{16}; for the *H* and *K* lines which are obviously far stronger than any others in the spectrum, 2300×10^{16}. These are huge numbers but they look different when you remember that the number of molecules in a single cubic centimeter of air under standard conditions is 2700×10^{16}—larger still.

The number of calcium atoms just calculated refer to those which have lost an electron and are ionized. The lines of the neutral calcium are much weaker and Unsöld finds that the number of atoms producing them is 3.4×10^{16} per square centimeter. Even at the high temperature of the Sun, such a great preponderance of ionized atoms can occur only if the pressure and density are very low, so that an atom which has lost an electron has a poor chance of picking one up again. Unsöld calculates that the pressure, so far as it originates from the motion of the electrons, is only a millionth part of our ordinary atmospheric pressure. The total pressure, including that arising from the gaseous atoms, may perhaps be 10 or 20 times weaker, but it is evident that the Sun's atmosphere is a very tenuous affair.

To make such exact measurements of the widths and contours of spectral lines is a laborious task, demanding powerful instruments. For the great mass of weaker lines a quicker method is desirable. This can be derived with the aid of the quantum relations of which we spoke a moment ago. There are many groups of lines called "multiplets" in the spectrum in which the relative numbers of atoms which are at work can be calculated, and in some cases it is found that more than a thousand times as many atoms will be absorbing one line than its neighbor.

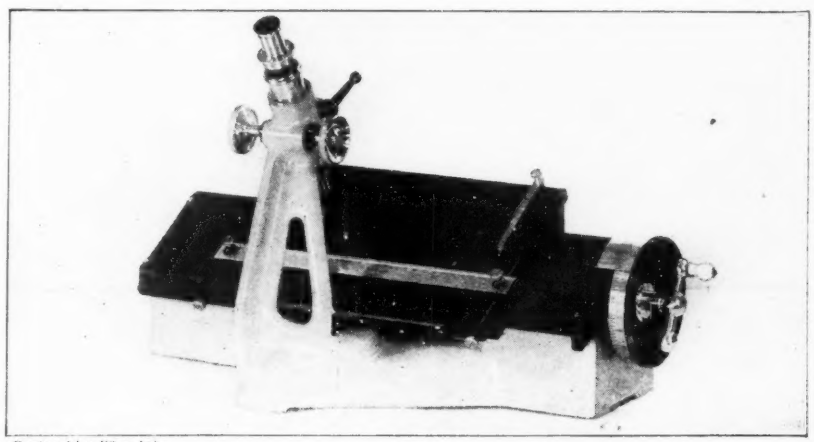
BY utilizing such cases it is possible to calibrate Rowland's arbitrary scale of the intensities of spectral lines and find the relative numbers of atoms which produce the lines to which he assigns different ratings. Hundreds of sets of these are available, and good results can therefore be obtained.

The results of such a calibration made here last spring by Dr. Adams, Miss Moore, and the writer, show that the numbers of atoms involved in the production of the different lines vary enormously. The faintest lines which can be seen on ordinary stellar spectra photographed with moderate dispersion are of about the intensity which Rowland called 1 on his scale. To produce such a line requires 2×10^{13} atoms per square centimeter—less than a millionth part of the number which produce the *H* and *K* line, or of the number of molecules in a cubic centimeter of air. In the solar spectrum, which can be photographed with powerful instruments, lines can be detected which result from the action of less than 1 percent of this number of atoms.

When a few more years of work of this kind have been done we should be in possession of the quantitative analysis of the atmospheres of the Sun and the stars. We ought then to have solved some of our present problems—and doubtless have a greater number of new ones to solve.

Some of the results obtained at the very start are striking enough; for example, the calcium lines are the strongest in the whole solar spectrum. Some other elements may be as abundant but have their spectral lines far in the ultra-violet where we cannot get at them. Allowing for this, it seems a fair guess to say that probably between 1 and 10 percent of the Sun's atmosphere consists of calcium vapor. It then follows from what has already been said that the whole amount of gas in the sun's atmosphere amounts only to enough to make a layer of the density of common air somewhere between ten centimeters and one meter thick, covering the Sun's surface.

AT first consideration it seems incredible that so little stuff should produce the host of lines in the solar spectrum. But if we set up an arc in the laboratory and feed it with common salt or get sodium into it in any other way the *D* lines will be found to be self-reversed, the cooler vapor in the outer part of the arc absorbing a dark center from the broad, bright line given by the hotter core. The sodium lines thus produced in a thickness of a fraction of an inch of vapor are often much stronger than those in the solar spectrum. This fact was observed by Sir Norman Lockyer more than 40 years ago. He drew the conclusion then that the solar atmosphere must be exceedingly rarefied, and this common sense conclusion is confirmed by the most modern work.—*Mount Wilson Observatory, February 5.*



Courtesy Adam Hilger, Ltd.

HOW SPECTRA ARE MEASURED

The spectrogram is clamped to the table, which may be moved under the fixed microscope by means of a micrometer screw. This arrangement permits accurate measurement

¶ *In an early issue Dr. Paul R. Heyl of the Bureau of Standards will give the readers what he has so often given them—something to think about. The thought-provoking article is entitled "The Strangest Thing in Physics."*

Animal Allies of the Physician

How Vaccines, Snake Bite Serums, and Antitoxins Widely Used by Doctors are Prepared in a Modern Serum Laboratory

By WALTER E. BURTON

WHEN you fall victim of smallpox, diphtheria, a snake bite, or any of a host of other maladies, your chances for recovery will depend largely upon a horse, calf, sheep, poisonous snake, or other creature. Many years ago it was found that the bodies of some animals are the best factories for making various kinds of sera used in the constant warfare against disease.

When the Spaniards brought to America alfalfa and cotton, two products which have created greater wealth than all the gold mines of the country, they brought at the same time, in the 16th Century, one of the greatest of scourges—smallpox. For many centuries the word "smallpox" was regarded as a synonym for death.

Today, thanks to the thousands of calves which have given their lives that humans might live, smallpox is no longer a dreaded disease. In the year 1870-71 over 125,000 French soldiers suffered from smallpox, and 25,000 of them died. During the four years of the World War the French army discovered only 12 cases, one of which was fatal.

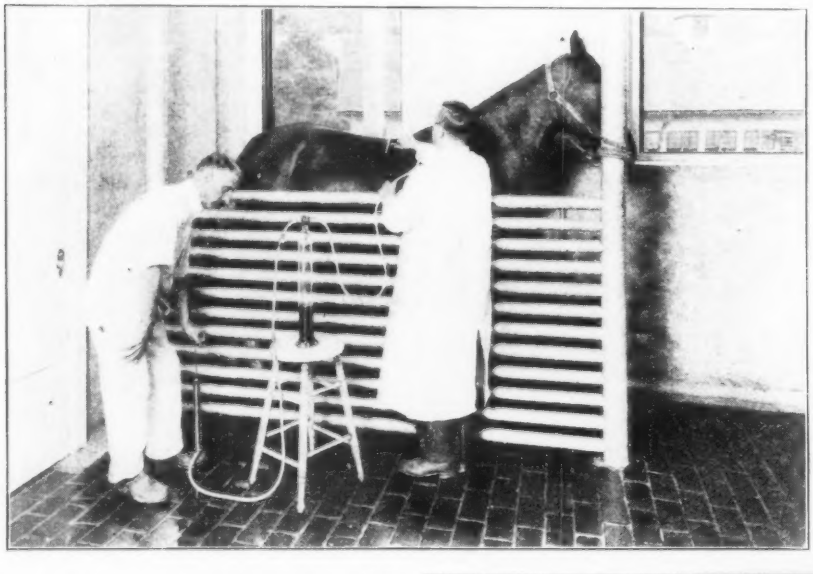
Calves used in the preparation of smallpox vaccine receive as careful treatment as the most delicate baby. They are fed on milk, and stand on sterilized slats, no bedding being used. They are kept for a time in quarantine, and are rigidly inspected before being inoculated.

A preliminary treatment consists of clipping the hair from the entire body of the calf and scrubbing the animal in an alkaline bath. Then, in the "barber shop" of the vaccine laboratory, a portion of the abdomen of the animal is shaved. Following this, the calf is transferred to the operating room where it is placed on a special table. The shaved surface is sterilized and numerous vaccinations are performed on the abdomen of the calf.

The animal next goes to a special room where it is treated with as great care as a patient in a modern hospital. From five to seven days after inoculation the virus is ready for removal. The animal is then killed and a post-mortem examination made to determine whether any harmful disease is present. After this, the pearly-white vesicles of "vaccine pulp" are removed.

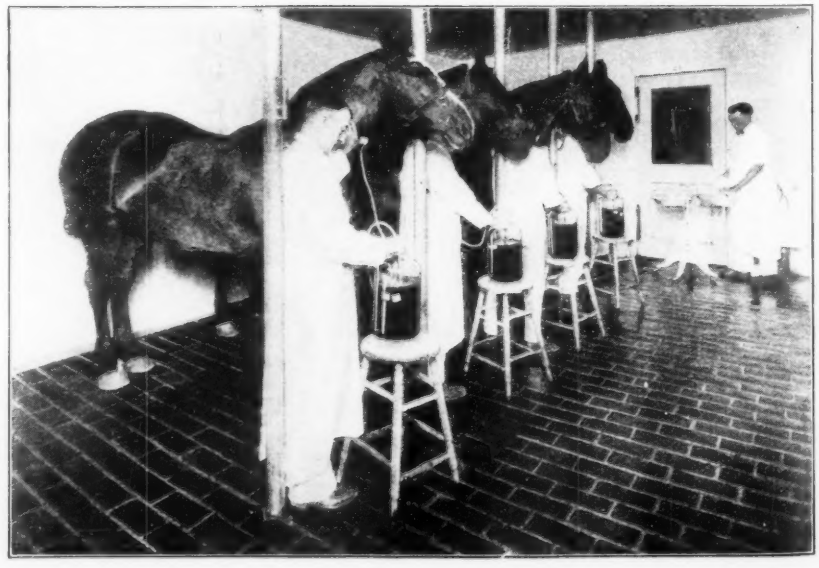
THE pulp is mixed with glycerine, in which form it is used as a vaccine. Careful tests of the material are made. In one of these a guinea pig is given 20 times the normal dose of vaccine to test for freedom of the material from harmful bacteria. The tested vaccine is placed in special containers in which it is sent to physicians the world over.

Diphtheria antitoxin is manufactured in the bodies of horses. A pure toxin is prepared by growing diphtheria bacilli in the laboratory, killing the bacteria, and filtering off the toxin. Beginning with a very small dose, and gradually increasing the amount, toxin is in-



◀ **DIPHTHERIA GERMS**

Injecting diphtheria toxin into a horse. It produces antitoxin for treating the disease



▼ **ENEMIES OF DISEASE**

Horses are bled from the jugular vein to get antitoxin developed for resisting diphtheria

jected into the horse at regular intervals over a period of eight to twenty weeks. Some horses do not prove to be good antitoxin-producers, while others may produce antitoxin for years.

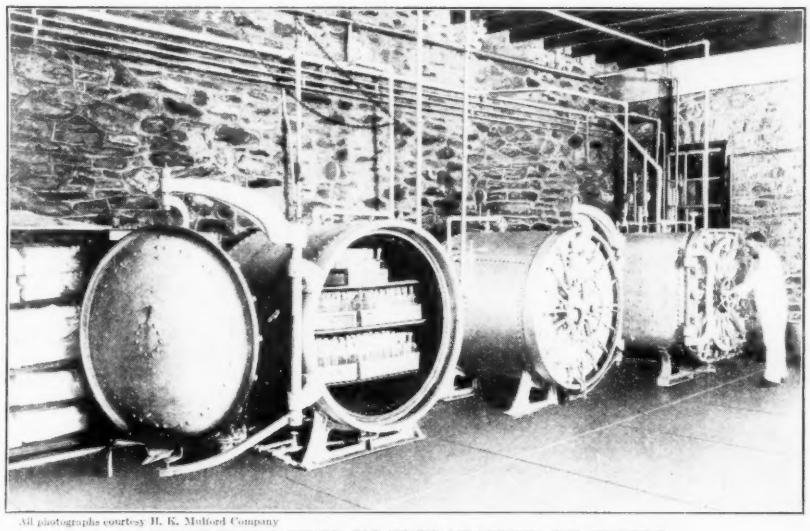
After the horse is highly immunized it is led to a bleeding room where an average of nine quarts of blood is drawn from its jugular vein. After the corpuscles settle, the pure serum is drawn off and concentrated by the ammonium sulfate method. In this form it is known as globulin. It is then filtered through porcelain, tested for sterility, toxicity, and unit value, and placed in glass syringes.

The story of Pasteur's work on the cure of rabies is too well known to be repeated. A more recent development is the vaccination of dogs against rabies. This method was developed in India, by necessity, for an English army post found it vital to have some kind of protection against the many stray dogs which infested the district. Later the method was used to overcome a frightful epidemic in Tokyo. The inoculation of a dog against rabies is done in a single, simple operation, and is no more painful to the dog than similar inoculation of humans.

TESTING ANTITOXIN

Cleopatra used slaves to test her snake poison; now guinea pigs sample antitoxin

IT is within comparatively recent years that the battle between man and poisonous snakes has been equalized in favor of man. Today, antivenin, (*nearctic crotalidae*) is widely used as a North American anti-snake-bite serum. This provides protection against the bites of rattlesnakes, copperheads, and others. It is put up in handy syringes which can be carried by the hunter, traveler, or other person who is likely to encounter poisonous snakes, and should be administered immediately following the bite, or of necessity within 12 to 24 hours. Antivenin will retain its potency for a period of five years after manufacture.

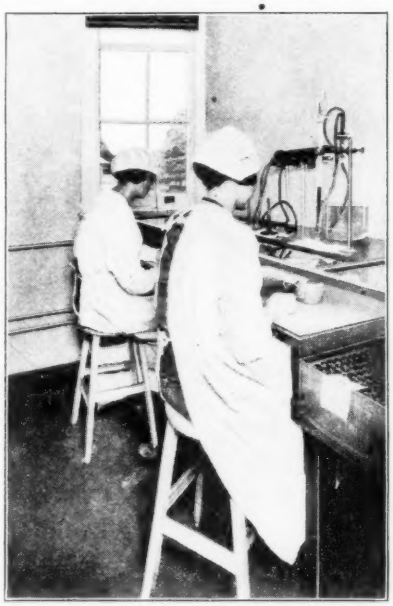


All photographs courtesy H. K. Mulford Company

STERILIZERS USED IN PREPARATION OF SERUM

A battery of sterilizers for purifying containers, culture media, and instruments to guarantee that the serum does not become contaminated with harmful bacteria or other foreign matter

In preparing snake-bite serum, venom from a moccasin or rattler is collected by letting the snake sink its fangs through a membrane-covered glass vessel. One moccasin will give from 30 to 40 drops of poison. Venom is then injected into horses in gradually-increasing doses over a period of about 16 months. Several days following the last injection of dry venom, the horse is bled. Three months after this bleeding the animal is ready for a repetition of the process. The anti-snake-bite serum is prepared from the collected blood, much as diphtheria antitoxin is made.



LOADING SYRINGES

Every sanitary precaution is followed when filling aseptic glass syringes with antitoxin

It is quite customary, in case of rattlesnake bites, to stimulate the heart and hasten the spread of the poison by drinking whiskey. When one is bitten by a snake the poison is injected directly into the blood, but the whiskey taken to counteract the poison goes into the stomach and can not be assimilated by the blood in time to offset the poison.

Of course, many more diseases are being combatted with sera, such as typhoid fever and tetanus. Some animal diseases, hog cholera for example, are likewise yielding to this type of treatment. It is hoped that eventually all human ills will be conquered by the serum method or by some equally effective means. When that day comes it would be a fitting tribute to erect monuments to the uncomplaining animals who sacrificed their lives that man's might be saved.

RATTLESNAKE POISON

Collecting the poison of rattlesnakes requires nerve as well as skill and the proper equipment

How People Differ Mentally

A Large Part of the Commonest Beliefs About Our Individual Powers and Limitations Are Not True

By DONALD A. LAIRD, Ph.D., Sc.D.
Director, Colgate Psychological Laboratory, Colgate University

THE individual was lost to psychology until the versatile English scientist Francis Galton tried to get the answer to some homely problems about human nature. Laws of memory and mental association that would hold for all human beings had engrossed the efforts of scientific students of human nature even before he unearthed certain spectacular findings. Laws for the operation of the senses had been thoroughly studied, but how one person differed from another had almost been neglected.

Probably these problems of how one person differs mentally from another are now arousing more interest than any other single group of problems in the field of psychology. Galton started the ball rolling in 1883 when his "Inquiries into Human Faculty" was first read by a scientific world bent upon finding how people were *alike*. The greatest applications of psychology in the schools and in industry, as well as in the mental clinic, are based upon how people differ rather than how they are alike. The laboriously unearthed facts in this rather new field are also of tremendous interest to the average individual.

This new field of "type psychology," "differential psychology," "individual psychology," "variational psychology," or whatever it may be called by the time this article is published, has revealed such interesting and even startling information as that contained in the following sentences:

THE slow worker is *not* the accurate worker. The old adage of "Slow but sure," or "Haste makes waste" has been found untrue—although it may be an excellent admonition for us individually when we are excited and attempt to work faster than usual.

The person with a good memory almost always has good reasoning powers also.

The hearing of the blind man is no more acute than that of the average person.

Practice in remembering the cards that have been played in a bridge game does not improve one's memory for names or faces.

Three or four people out of every hundred are unable to tell red from green; men have this defect more commonly than women do.

A mental age of twelve years is essential for one to drive an automobile safely; there are several hundred thousand adults in the United States alone who do not have this rating. (I know of no scientific data on "back seat drivers".)

The best time for learning is from about 16 to 25, but learning capacity at 40 is but little less than at 20.

PRACTICALLY every person has some marked weak spots in his mental equipment, regardless of how accomplished or skilled he may be.

Brain size or head shape has little to do with an individual's mental capacities.

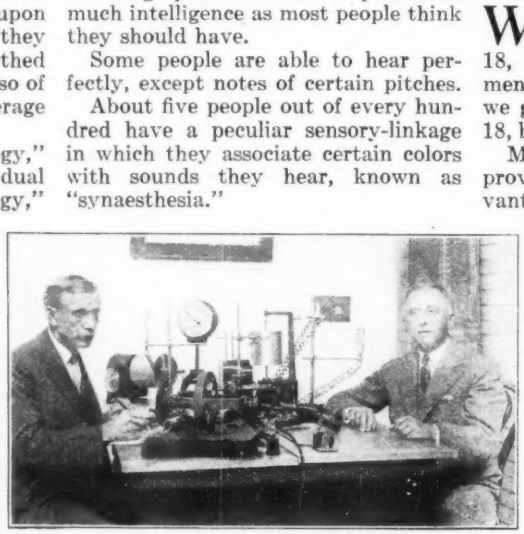
Individual differences in blood chemistry *may* have a close association with mental differences.

The charming after-dinner speaker may be a total failure at writing letters.

College professors do not possess as much intelligence as most people think they should have.

Some people are able to hear perfectly, except notes of certain pitches.

About five people out of every hundred have a peculiar sensory-linkage in which they associate certain colors with sounds they hear, known as "synaesthesia."



REACTION-TIME MACHINE

The time required to react to a signal is important in recording individual differences. This machine, devised by Dr. Knight Dunlap of Johns Hopkins, measures it

Some people can work with decreased fatigue after being irradiated with ultra-violet rays, while other people are more fatigued after the exposures to these rays.

Practice has the surprising effect of making the differences in mental ability between two people all the greater, the one who is more able at the start of the practice usually improving the more.

Some high school pupils can add simple arithmetic problems six times as rapidly as other pupils in the same classes.

Some women have three times as much strength in their right hand as other women have.

Some people can tap with their left hand only 20 times in half a minute, while others can tap 225 times in the same interval.

Brothers and sisters resemble each other mentally more closely than do unrelated boys and girls. Twins have a closer mental resemblance than mere brothers and sisters.

Probably there are not two people in the world with exactly the same mental make-up.

Environment may mould these individual differences somewhat, but it is not the cause, and does not generate the differences.

Country boys and girls grow more rapidly than children living in the city.

WE continue to grow in general intelligence at least up to age 18, and do not stop at 14 as early mental testers had thought. Perhaps we grow in this trait after the age of 18, but this is not yet definitely known.

Most of our sensory capacities improve with age. This has its disadvantages as well as its advantages, but not in the exception of pain. Here the sensitivity decreases as we get older.

Some children are able to make keener discriminations of musical pitch than the average adult.

Mental growth from childhood to maturity is not regular and uniform; some functions improve rapidly while others stand still; just when one high school girl may be improving in visual acuity another may be making no progress in this trait.

At about age 12 most girls have a pre-adolescent spurt in mental development, while boys do not have this spurt until they are a year or more older.

Sensory capacities mature sooner than those of the higher mental processes.

Brain cells are actually lost as we get older. By the time one is 75 there may be the loss of as much as 100 grams from the cerebrum.

Memory, originality, and initiative seem to suffer most with advancing age.

College men are better at arithmetical reasoning than college women.

The average woman has keener sensory acuity than most men; also, she usually excels in memory.

In proportion to their intelligence girls usually display better scholarship than boys.

A girl has to be more feeble minded than a boy in order to be taken to an institution for the feeble-minded for care.

It is possible that men vary more in their abilities than women do; that is, there may be more geniuses and "numb skulls" among the men.

The average white person grades about two mental age years above the average colored person.

The negro is more like the white man in sensory capacity and muscular control than he is in the higher mental processes.

Whites mature at a later age than do negroes.

THE Hawaiians are probably the most intelligent of the brown races.

Nothing scientifically acceptable is known about mental differences among the white races.

One can be a skilled machinist without being particularly gifted intellectually.

Genius is *not* a close relative of insanity.

Age of parents does not appear to have a determining part in the abilities their children will possess.

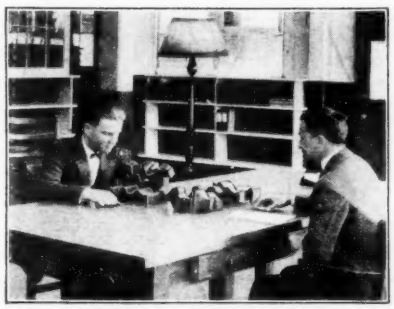
Children of large families are usually less intelligent than those of small families, although there is a tendency for men of great genius to be born in large families.

The oldest child is usually the most gifted in the family.

An unusually large percentage of delinquents and criminals are feeble-minded or closely border on mental disorder.

More intelligence is required to be a successful baker than a successful farmer.

City school children usually possess better mental abilities than country school children. The difference is not due to poorer teaching in the district schools of the country regions.



WIGGLY-BLOCK TEST

The task is to assemble all of the irregular blocks so that they form a perfect cube

The average intelligence of men is greatest in Oregon, and least in Mississippi; the difference is about two and a half mental age years.

The newer generations of Negroes are more intelligent, due to an admixture of appreciable amounts of white blood in their veins.

Pioneers have almost invariably been better equipped mentally than the people who stayed at home. It is not so much because the city offers better opportunities that more succeed there; it is partly due to the more intelligent young people leaving the country and coming to the city as present-day "pioneers."

Almost anyone can make an average success in any occupation.

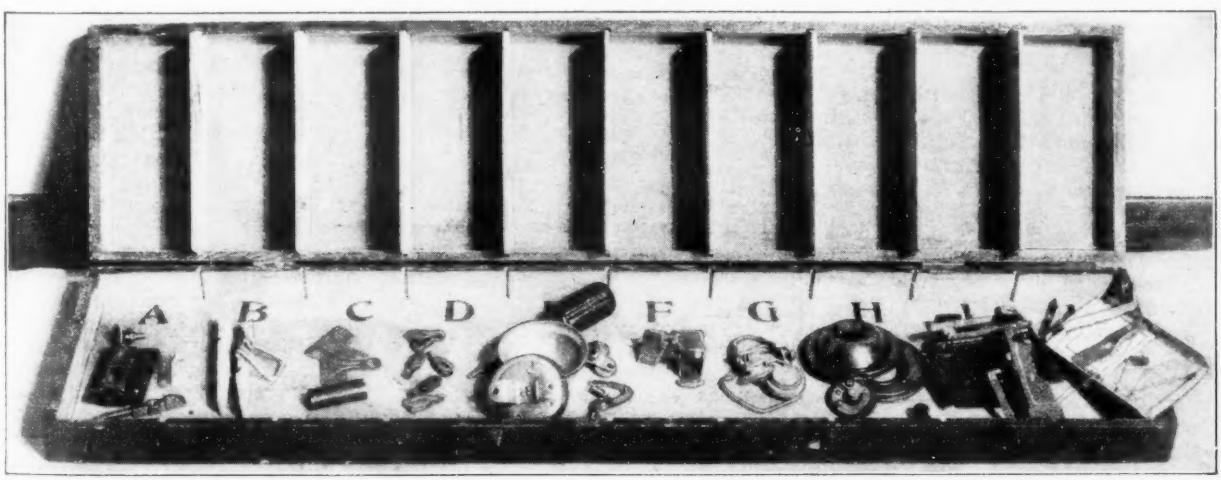
In most occupations the best person is three or four times as capable as the poorest.

The individual who is eminently successful may be a total failure in other occupations. Napoleon—who himself was a wretched speller—appointed the great mathematician Laplace to an important position in his cabinet, where the mathematician proved to be hopelessly incompetent.

IT is apparent from all these fragments taken from the results of recent psychological research that human nature is the most unstandardized thing on earth. And in this very quality of variability and difference probably lies the great fascination human nature offers for study or just plain enjoyment.

Galton, the Englishman, and James McKeen Cattell, the American psychologist, started the veritable deluge of laboratory work that has resulted in the discovery of the individual. This study of individuals is probably consuming the research activities of between 200 and 300 American scientists. Despite the amount of highly practical information that has been accumulated, the greater part of the work still lies ahead, beyond the peradventure of a doubt.

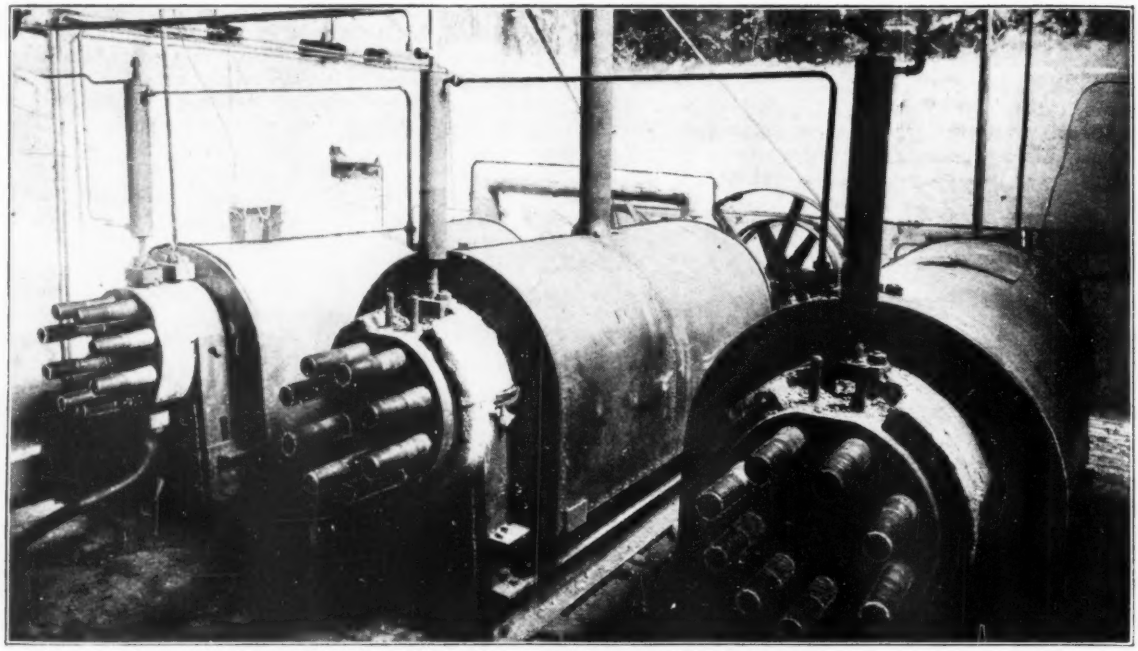
Department stores, factories, and taxicab companies have engaged specialists to study and select individuals who are predicted to be best adapted for various jobs, but I know of no enterprise which is attempting to make all human beings alike. Old-fashioned psychology implicitly assumed that we were all alike, and many laws were formulated from the arm chair, in precise language. These old laws have now been transcended by one great law—that no two individuals are exactly alike in their mental constitution. Each one is not a law unto himself, but each is himself. Yet we see many people who are trying to be like somebody else when their primary task should be to find out their real selves and how best to express this individuality in work and play.



All photographs courtesy Psychological Laboratory, Colgate University

A MECHANICAL MENTALITY TEST

Could you assemble, without difficulty, the various simple household and shop appliances illustrated here. Some women can do this better than men. The test was devised by Dr. John L. Stenquist, in charge of giving mentality tests in schools of Baltimore, Maryland



WHERE COAL IS TRANSFORMED INTO GASOLINE

View in an experiment station at Mannheim-Rheinau, Germany, in which is liquefied about a ton of coal a day. The production of gasoline from coal is now an important industry in central Europe, yielding about 25 million gallons annually

New Uses for Coal and Wood

Scientists, Seeking New Industrial Uses for Wasted Raw Materials, Produce Gasoline from Coal and Seek to Make Food from Wood Pulp

By DR. FRIEDRICH BERGIUS
Heidelberg, Germany

THE recent discovery of the hydrogenation of coal, which formed the basis of the new technical process of liquefying coal, was the outcome of research work that had been undertaken for the purpose of obtaining a better knowledge of the chemical relation between wood and coal.

Coal and wood are related in more than one respect. At first both were used to produce energy. However, during the last century and a half, wood as a fuel was pushed to the background considerably, while coal came more and more into its own. This technical development undoubtedly has been logical in an economic sense. To burn wood, that is, transform it into carbonic acid and water, means to destroy a valuable group of carbohydrates. It is significant that this group differs only slightly from those carbohydrate compounds in the human body which, by a most rational process of combustion and conversion, are used up in the processes of animal life.

But the relationship between coal and wood is not merely technical or economic. There is every evidence that wood and similar vegetable matter may be regarded as the basic substance from which coal developed. Vegetable substances, protected from the influence of air by being immersed in water or covered with soil, undergo an extremely slow chemical reaction, known as the "incoaling reaction." This process, at ordinary temperatures, takes millions of years for its completion.

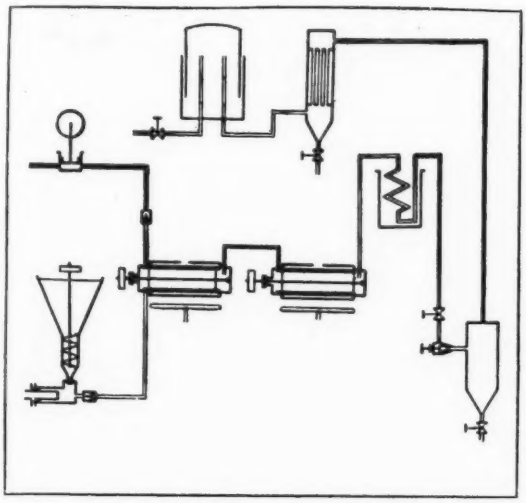
Master of Research

ONE of the greatest problems before men of science is the search for economically feasible methods of utilizing our more abundant raw materials. In this country, as well as in Europe, Dr. Friedrich Bergius is recognized as an outstanding authority on this subject. We are pleased to present Dr. Bergius' own story of his successful research.
—The Editor.

In the course of geological epochs, this reaction has transformed vegetable substances into what in our day is the most valuable source of energy in industry as well as for domestic purposes—coal. It is evident that knowledge of this incoaling reaction is of great importance to the chemist who wishes to gain a thorough insight into the chemical process underlying the formation of coal.

To be able to study it in his laboratory the chemist must find a method of accelerating this reaction. The usual way to speed up a chemical reaction is to subject the substance to higher temperatures. But when applying this method to the incoaling reaction, a great difficulty is encountered; this reaction, being an exothermic one, liberates a very large volume of heat. If no means are provided to lead off this heat from the reacting material, overheating occurs and the product is not coal, but a superheated coal, which has changed its chemical composition.

In 1910, working with my collaborators, I undertook to work out a method for the exact control of temperatures during this reaction, by heating vegetable matter to the required reaction temperature of about 340 degrees, Centigrade, in the presence of water in liquid form. To avoid



HYDROGENATION PLANT

This diagram shows the continuity and general arrangement of a plant designed for the liquefaction of coal

evaporation of the water we had to work under a very high pressure of about 200 atmospheres. In this way we succeeded in obtaining an exact control of the physical conditions and it became possible to study the different stages of this incoaling reaction.

The results of these experiments proved, for example, that when wood pulp (cellulose) was used as the basic material, the chief products of reaction were carbon dioxide, water, and a product which, according to its chemical characteristics, was of practically the same composition as bituminous coal, provided that the reaction was carried through for about 20 hours at a temperature of 340 degrees, Centigrade. The quantity of carbon dioxide and water formed during the reaction, as well as analysis of the final solid product, gave us an idea as to the chemical nature of this artificial coal, and it seemed likely to us that there might be a possibility of transforming this artificial coal into liquid hydrocarbons by treating it with hydrogen under very high pressure. Further experiments proved that this line of procedure was correct, and that it was possible at about 400 degrees, Centigrade, to transform artificial coal into hydrocarbons through the action of compressed hydrogen. Later we proved that natural bituminous coal could be transformed in exactly the same way.

THE results of these experiments formed the basis of the first patent for the liquefaction of coal, which was applied for in 1913. We succeeded in producing about 60 percent of oil from coal, a certain percentage of which consisted of oxygen-containing compounds, especially phenols. The remaining 40 percent consisted of the inorganic material of the coal, of gaseous hydrocarbons, water, and some solid organic residue.

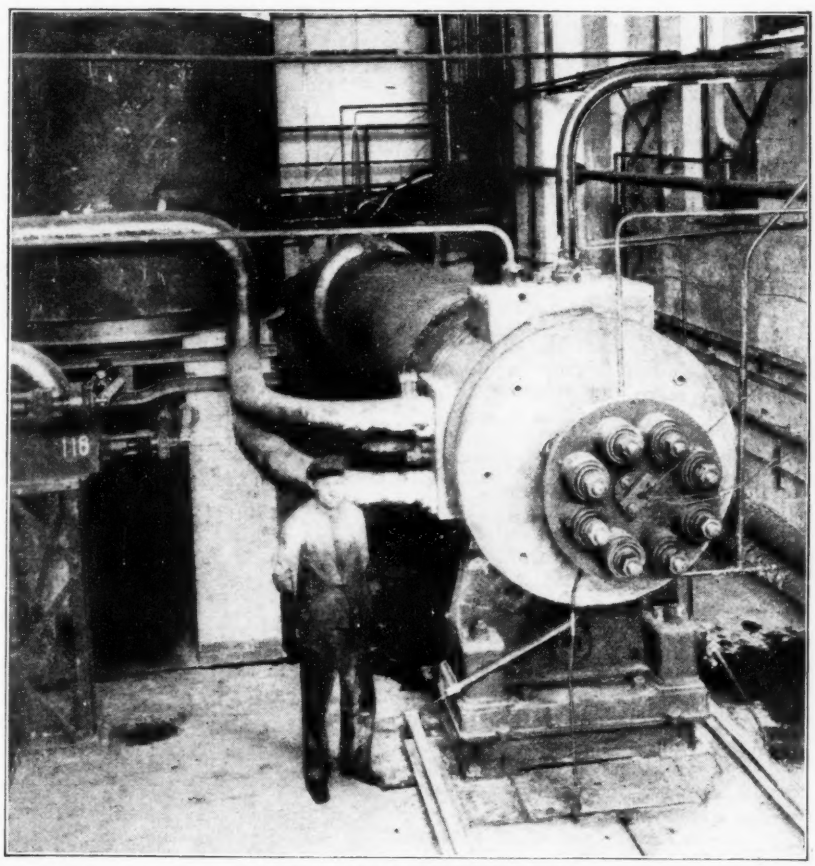
Following these first laboratory experiments, many years' continued efforts were required to perfect a commercially practical process based on this chemical reaction. Besides the chemical difficulties, the greatest obstacle to be overcome was the lack of adequate machinery, which had to be designed and constructed to withstand pressures of more than 2000 pounds per square inch.

Means had to be found for the continuous and uninterrupted supply of coal into high pressure apparatus, for the exact control of temperatures, and for the construction of high-pressure valves, stuffing boxes, and similar details of machinery. More than a decade of effort in the chemical and technical field, by a large staff of engineers and chemists, culminated in 1925 in the establishment of a process for the liquefaction of coal that has proved technically and commercially sound.

Two years ago the I. G. Farben-Industrie, the great German chemical combine, undertook to erect a commercial plant for liquefying coal on a large scale. This plant, which at present produces 70,000 tons of gasoline per year, is being enlarged to a capacity of about 250,000 tons annually. Through some new developments of this process it will be possible to transform the entire quantity of the liquid products obtained from coal into gasoline.

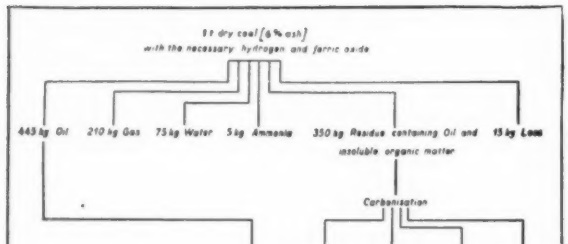
FOR 12 years our entire interest was focused on coal, its origin and chemical composition. This was closely bound up with our next objective, namely, research into the chemical composition of wood. In connection with the laboratory research that led to the establishment of the chemical reaction transforming vegetable substances into coal, it became apparent that, through a more conservative treatment of wood, aiming at the conservation of the valuable skeleton of carbohydrates residing in this product of Nature, new ways might possibly be found to preserve the precious natural resources of the forests which are now being recklessly wasted.

The carbohydrates are the essential part of wood and of many other agricultural waste products containing cellulose.



A LARGE COMPRESSION UNIT

This high-pressure vessel, a part of the original liquefaction plant, is 24 feet long and three feet wide. Each vessel withstands pressures of more than 2000 pounds per square inch


1 t dry coal [6% ash]
with the necessary hydrogen and ferric oxide
445 kg Oil
210 kg Gas
75 kg Water
5 kg Ammonia
350 kg Residue containing Oil and insoluble organic matter
15 kg Loss
Carbonisation
80 kg Oil
240 kg Coke [including ash]
25 kg Gas
5 kg Loss
150 kg Neutral ref motor-spirit [boiling range 30–230°C]
200 kg Diesel oil and creosote oil
60 kg Lubricating oil
80 kg Fuel oil
35 kg Destillation and refining losses

FROM A TON OF COAL

Yields from one ton of bituminous gas-coal by the Bergius process of liquefaction, showing the numerous by-products

They are also one of the essentials of nutrition, directly or indirectly, for both human beings and animals. They represent a concentrated product of the sun's energy and in the process of metabolism serve as fuel to produce the various kinds of energy which sustain life. In plants, Nature provides carbohydrates under various forms, rendering them a useful aid to digestion with nearly all animals, while there are those also which are only fit for use by a myriad of so-called lower organisms, such as microbes.

Carbohydrates differ only very slightly amongst themselves as regards their elementary composition, but these small differences divide them into two classes, according to their commercial value.

THROUGH the gradual evolution of agriculture in the course of the ages, some plants have been developed which contain carbohydrates in forms making them available for use as food for man and for cattle. There are other carbohydrates produced by Nature and occurring in larger quantities, which, however, are less readily digestible in the stomachs of man and beast. Outstanding among these is cellulose, which forms a very large percentage of the waste products of agriculture, and chiefly of wood.

Enormous quantities of such waste products are available in the United States, especially in the form of corn stalks. In the timber industry, at least 40 percent of the wood is discarded as waste, being put to no use at all, or, in rare instances, serving as fuel. But, as already pointed out, to burn wood means to destroy the valuable chemical inner structure of cellulose.

The prevailing enormous demand for newsprint jeopardizes the wood supply of the future. If a contingency should arise to turn the waste of the forests into human or cattle food, it would undoubtedly have a vast influence in shaping agricultural and forestry policies throughout large areas.

From these considerations we come to another problem. Can chemistry succeed in so altering the cellulose molecule that it may be made to assume a form rendering it just as digestible in the stomach as are starches and certain sugars? It has been known for more than a century that this can be done in a small way through a simple chemical reaction, namely, by adding one molecule of water to one molecule of cellulose. There is the difficulty, however, that the old established chemical reactions, although carried on easily enough in the laboratory, present enormous obstacles when put to the test on a commercial scale.

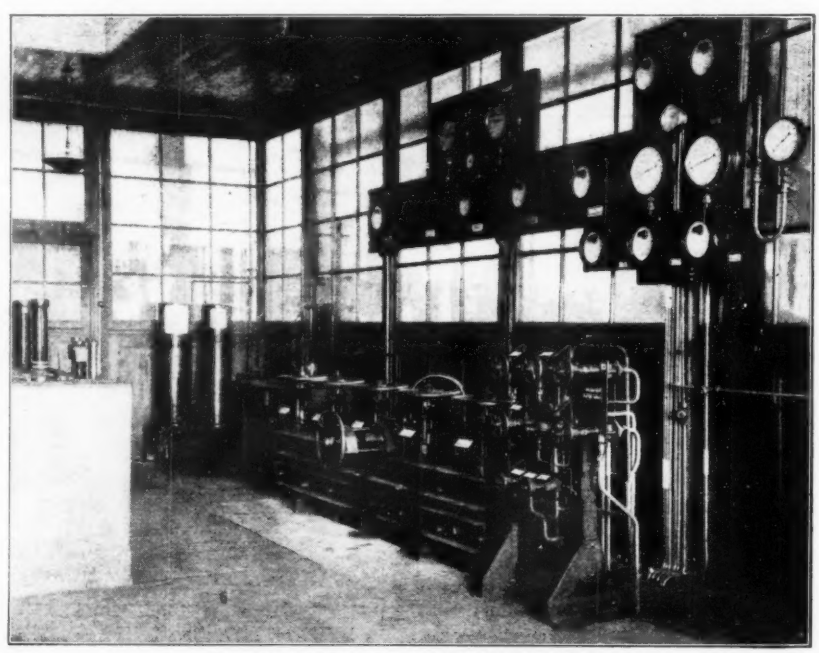
A number of processes that have been evolved in the course of time establish chemically the reaction of cellulose hydrolysis, the first practical application thereof having been made in the United States, near Chicago, many years ago. The aim of all these processes has been to transform cellulose into a product that could be subjected to fermentation, to be used in the manufacture of alcohol. Up to now all these methods have failed economically, as the yields of fermentable material have been far too low.

While the production of alcohol has been the ultimate goal of all these processes of hydrolysis of cellulose at high temperature, a new technical method has been developed in Germany in the course of the last 12 years, having for its aim the transformation of cellulose into a foodstuff.

Willstaetter, in 1913, found that through the action of hyperconcentrated hydrochloric acid, transformation into soluble carbohydrates, and eventually into glucose, could be brought about. With these laboratory results as a basis, a technical process has been evolved through which 100 parts of dry wood of any kind can be made to yield 75 percent of a crude foodstuff containing 80 percent of pure carbohydrates. This product proved to be of high nutritive value and equal to any other foodstuff of starchy consistency, and is particularly adapted for hog raising.

IN my country—Germany—where not sufficient agricultural carbohydrates are produced for cattle food, but where there is a rather large supply of wood waste, this new industry may become an important economic factor. It may also prove to be of use in America, since the problem, for example, of disposing of the corn waste in the fields, is assuming serious proportions because of the increasingly destructive activity of the corn borer.

However, the technical problems of each country need to be studied separately, and only perseverance, faith, and a great deal of optimism, not to mention time, are necessary to develop a successful industry of this kind.



VIEW OF CENTRAL CONTROL ROOM

Controls to insure the uninterrupted supply of coal into high pressure apparatus, and instruments for the exact regulation of temperatures and pressures involved in the process

OUR POINT OF VIEW

Half Truths

THE United States expects to find distorted discussions of our navy's strength, its purposes, and its "anti-British" policy in the English dailies; they generally pander to the masses. But when British periodicals in high standing publish articles comparing navies of the world and make, not one but many, erroneous statements regarding the United States Navy, it is to be wondered whether their errors crept in unwittingly or were included by design.

One reputable technical magazine, published in London, recently stated that we are to build four destroyer flotilla leaders "in the near future." Another of the same high character said that we have "projected" nine of these valuable ships. It is difficult to understand how they arrived at these figures since the records are clear for all who desire to see them. We have neither projected nor are we to build any flotilla leaders soon and it is doubtful if we build any even in the far distant future. Cruisers are far more desirable at this time and it is difficult enough to get appropriations even for cruisers. Twelve flotilla leaders were authorized in 1916, are not built yet, and there seems slight prospect of our getting an appropriation for them for many years to come.

The first magazine made a sweeping statement which let it be understood that the angle of elevation of the guns in the main batteries on 11 of our battle-ships had been increased to 30 degrees, whereas this change of the main battery guns could be made on only two. The second magazine stated that we have 309 destroyers although the records show only 262 under the effective age of 16 years and eight over that age. Both magazines made several other mis-statements which we shall not take space to detail here.

The point is that, while misleading statements and half-truths will surely continue to come from both sides, it is to be expected that reputable publications be sure of their facts and shun anything that savors of propaganda. Those people in America who favor our present naval program are not afraid of facts whether inimical to their cause or not; but they do want fair play. If British publications wish to discuss the United States Navy, they may express as many and diverse opinions as to them seems fitting; their facts, however, should be obtained from authorities, should be carefully verified, and as carefully proof-read when in cold type.

The Alloy Age Looms Up

THAT an Alloy Age would come, following the Ages of Stone, Copper, Bronze, and Iron, has been a logical prediction for some time, but possibly no single event has so strongly threatened to tip the world of industry in its direction as the discovery of the new cobalt-carbon-tungsten alloy Carboloy, described in our March issue.

A cutting edge is a commonplace thing—too commonplace, perhaps, to be appreciated by most of us. Yet it is literally man's most valuable material asset. If one inclines to doubt this broad claim let him imagine a world suddenly robbed of cutting edges. To make the things he requires, man would have ten fingers, those few pieces of wood which nature happened to leave in ready broken form, and stones capable of being used for crushing. A million years of cultural evolution would have been lost. In the last analysis, then, human advance above the ape stage has been almost wholly contingent on the ability to *shape things*, and this demands cutting edges harder than the things to be shaped.

How futile is the assumption occasionally made, that we have at last reached the summit of perfection in cutting edges or anything, has already been made manifest by the recent discovery. Even if the new, almost diamond-hard alloy cost as much as ten times its weight in gold it would be worth the price if it provided a cutting edge which would enable one workman to turn out two pieces of work where he turns out one today.

Human Sheep at Sea

SINCE the sinking of the *Vestris*, sea safety ideas have been advanced by the thousand. Some have been good, some indifferent, and others impossible. Few, however, have touched specifically on the human element.

Human beings in a panic, whether on land or at sea, are usually like herds of sheep; they lack organization and discipline and often nullify the efforts of those who would aid them. It has recently been remarked that ship passengers consider as a joke and a nuisance the life-boat drills which, according to rule, must be carried out regularly. There is no excuse for this attitude; in fact, it may turn out to be suicidal. The first law of nature—that of self-preservation—should excite an earnestness in the proper execution of these drills despite the seeming security of the ship.

It is difficult to prescribe in this case, but it seems that, since life-boat drills are looked upon as a joke, advantage might be taken of this fact by making a game of them. The captain could award prizes—a special dinner, special privileges, or something of the sort—to the boat load of passengers who got to their places most quickly and with the least trouble. If this proves ineffective, perhaps the captain should be empowered to confine to his cabin for the remainder of the trip any passenger who fails to respond to the boat-drill signal. The former method might be a lot of fun but the latter would certainly not be a joke.

Industrial Doctors

FIGURES compiled by the Chemistry Department of the University of Wisconsin show, according to reports, that industry is daily showing a greater appreciation of men who have been educated in the higher branches of science. Since the World War, 56 out of 109 persons who received the degree of Doctor of Philosophy in that department at Wisconsin have gone into industrial work. Previously, since 1899 when the first degree of the kind was given by the department, only eight persons had entered the ranks of industry.

This is not exactly news—but the figures are. Other institutions of learning could, if they would, show figures as startling if not more so, we are sure, for we have been aware of the situation for some time. Industries have already reflected this progressive spirit in their products. When more and still more doctors of philosophy turn their knowledge to the achievement of practical results, it is certain that we may expect a larger variety and finer class of industrial products than ever before.

Embryonic Schwabs or Fords or Edisons without university educations, however, need not feel that this ever-growing partnership between science and industry will shut off opportunity for them. It will, if anything, only serve to increase the field of industry's operations so that, in the end, more and still more persons of all ranks may share in the progress.

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Cross Examination Under Anesthetics

FOR several years various movements have been promoted to study the effects of drugs on the mentality. Dr. R. E. House of Texas some years ago urged the use of scopolamin in criminology, claiming that the criminal under the influence of this drug has his will inhibited so that he would invariably answer all questions truthfully and that in this way the detection of crime would be much easier.

Not long ago a boy in Hawaii was abducted from school and killed. A Japanese boy who had been the chauffeur in the family was arrested, and steadily maintained his innocence. He was given a drug, and while under its influence confessed to the commission of the crime. When the drug had worn off he repudiated his confession. Then it was found that he had been in no way connected with the crime and the real murderer was discovered elsewhere.

British periodicals commenting on the case pointed out that persons accused of crime are first warned that everything they say may be used against them. A method which tricks the suspect and catches him off his guard is therefore contrary to justice and to procedure in English courts of law. The case occurring in Hawaii probably spells doom to all further efforts in promoting this method of obtaining confessions.

Vitamin C in Green Tea

RECENTLY Japanese tea growers have been publishing extensive advertisements to indicate that the drinking of green tea would provide the individual with a considerable amount of vitamin C, the vitamin that is found largely in orange juice and fresh vegetables. Its absence results in the appearance of scurvy or of the symptoms associated with this disease. In the preparation of green tea, the leaves are dried without fermentation. Fermentation previous to drying, results in black tea. For this reason it had been argued that sauerkraut and ensilage are devoid of vitamin C.

In order to study the matter scientifically, Drs. Mattill and Pratt of the University of Rochester, New York, undertook a series of tests on guinea-pigs in which scurvy had been produced by feeding a diet deficient in vitamin C. As a result of their investigations they report that green tea, even though it has some vitamin C, is of limited value for the prevention of scurvy. It cannot be used by children and should not be used by adults to replace natural foodstuffs which meet additional nutritive requirements.

Tea is not infrequently used as a part of the ration by explorers and military expeditions. In such cases it must be understood that tea is of service as a cheering drink, containing a certain amount of caffein, and that it is not of great importance as a nutritive substance or for its vitamin content.

Undulant Fever

THE sensation of the early part of 1929 in medical circles is the appearance of a considerable number of cases of a disease called undulant fever, which has been identified as the same condition as Malta or Mediterranean fever, and which has been shown by bacteriologic and immunologic studies to be associated with contagious abortion in cattle.

The first human case of undulant fever was described in the United States in 1903 by Col. C. F. Craig of the United States Army Medical Corps. More than 30 years ago David Bruce, the famous British investigator, identified the organism of Malta fever, and it now bears his name, since it is called *Brucella melitensis*. Later, Dr. Alice Evans of the United States Public Health Service established a definite relationship between contagious abortion in cattle and Malta fever in human beings.

Since that time it has been realized that the disease can be transmitted not only by the milk of goats, but also through contact with infected cattle, hogs, or horses. Through investigations completed by A. V. Hardy of the United States Public Health Service, cases have been found among workers in packing houses, on farms, and in small towns. Hence the problem of stamping out the disease among those handling infected stock is a pressing one.

Undulant fever is so-called because its chief symptom is a fever which comes and goes in waves, and which lasts in the mild cases about three months, but in the more serious cases as long as three years. The disease resembles typhoid fever, heart disease, or tuberculosis in the early stages and is differentiated from these conditions only by a specific test of the blood, similar to the Widal test that is used for typhoid fever.

Cases have already been reported from practically every state in the Union. The problem of prevention seems to be the control of the three "f's"—fingers, food, and flies. Workers with herds of cattle in which contagious abortion has occurred must be particularly careful about hand hygiene. Milk should be pasteurized, and screens will take care of the fly problem.

Narcosan and Drug Addiction

ALMOST two years ago the startling announcement was made that investigators in the Blackwell Island Hospital in New York had discovered a cure for drug addiction in the form of a mixture of protein substances called narcosan. At the time the *Journal of the American Medical Association* pointed out that the evidence was highly doubtful and that the record of the promoter of the new preparation was not such as to inspire confidence.

A special committee appointed by the Mayor of New York, headed by Dr. Alexander Lambert, has made available the results of an investigation carried on in the Bellevue Hospital since May, 1928, with a view to establishing definitely the actual merit of the narcosan preparation. The narcosan treatment was given to 68 patients who were carefully watched and who were compared with other patients treated by the usual general measures. The committee reports that the symptoms occurring in patients receiving narcosan were more severe than in those not receiving narcosan, and the results show clearly that narcosan has no merit as a specific treatment of drug addiction.

Hair-A-Gain Exposed

OF all the substances promoted for the delusion of mankind, none is so prolific of humor and comedy as those having to do with the human

hair. In such cases men are notoriously credulous. Furthermore, since the time of Elijah, man's head despoiled of its hirsute adornment has been the subject for the jests of the comedians.

The *Journal of the American Medical Association* recently investigated "Hair-A-Gain" scalp and hair shampoo promoted by a lady in Los Angeles as a product which would enhance the beauty, sheen, luster, color, and texture of the scalp and hair. Analyses made in the laboratory of the Association indicate that this product has simply a tar or tar-like substance as a base and that it was sufficiently strong in some cases to take off the surface of the scalp.

Nevertheless it was promoted with the claim that it would restore grey hair to its natural color, as well as grow hair on bald heads. As with many other nostrums in this field, the radio has been used largely in its promotion. It should be unnecessary to tell any intelligent reader that only hair dye will give grey hair a dark appearance, and that in the majority of cases of hereditary baldness, so far as is known, there is nothing that will cause a growth of new hair.

Clothing and Man

THE eminent English physiologist, Prof. Leonard Hill, has recently considered the effects of clothes on the human body. Primitive man used clothes primarily for display, since he was little concerned with keeping himself warm or protected against the elements, unless insects are included in the latter category. Human beings vary in their ability to stand exposure. Thus channel swimmers spend 20 hours in the cold sea with only a wool bathing suit and a coat of grease, whereas a preacher who consulted Professor Hill wore a thick woolen vest, a woolen shirt, a woolen lined waistcoat, a cardigan, a tweed suit and a woolen lined motor coat. Probably even with these he still complained of the cold.

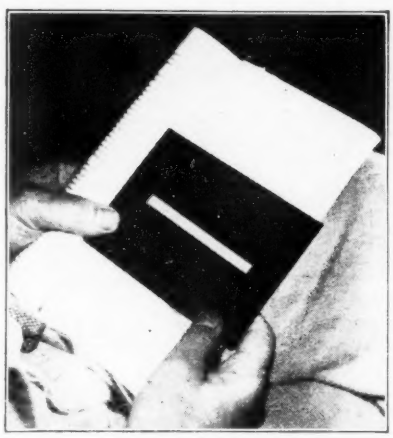
The dress of woman has changed largely in recent years and has given much concern to the physiologists. Professor Hill points out that a civilized man when naked and quiet finds exposure to still air at 95 to 98 degrees, Fahrenheit, not unbearably warm, 76 to 86 pleasant, 60 cold, and 40 to 50 very cold. For sedentary occupations he wants the atmosphere under his clothes to be 95, and only about 20 percent of the body's surface to be exposed to the air.

On the other hand, people used to being outdoors can stand much colder temperatures, and children vary in their garments from those accustomed to thin garments and bare knees to those in elementary schools in foreign districts who will wear as many as 14 different garments, some of these sewed on for the winter.

It may be taken for granted that in the majority of cases children are being overclothed, and as a result do not develop any resistance to exposure. On the other hand, insufficient clothing for the child may lead to a prompt response with numerous illnesses during infancy. Perhaps the question will never be settled until human beings have standardized clothing as they now standardize most other affairs in human life.

Diseases of the Eye in Old Age

IN a symposium on diseases of the eye in old age, Dr. W. H. Wilmer of the Johns Hopkins Hospital, Baltimore, recently considered particularly the diseases of the eye and the changes that occur in the eye with age. The whole eye tends to become smaller as people become older. The skin around the eye becomes thinner, less elastic, and folded so that the typical crow's-feet form. The muscles of the eye are likely to weaken, if not to become paralyzed with advancing age, and the delicate tissues harden, the changes interfering with vision. The iris or colored matter of the eye undergoes senile changes with the formation of little granules that appear like small particles of black pepper.



READING SLOT

This device is said to be of value to the eyes of the aged. Description is in text

There is a tendency also for the iris, which controls the size of the pupil, to become thicker and more rigid so that the pupils of the eyes of old people are smaller and less easily movable than in the young. The lens of the eye grows larger throughout life and in very advanced age thickens, while deposits form within it. From early youth on, the inner portion of the lens increases in size and hardness until in advanced age the lens is practically all nucleus and is inelastic. The senile lens is particularly subject to the development of cataract.

Becasue of these changes, the upper eyelid tends to droop in the aged, and Doctor Wilmer suggests that the lid can be raised by the fingers or supported by a device fastened on the upper rim of the spectacles. It is also possible through surgical operation to take out a portion of the lid, making it shorter.

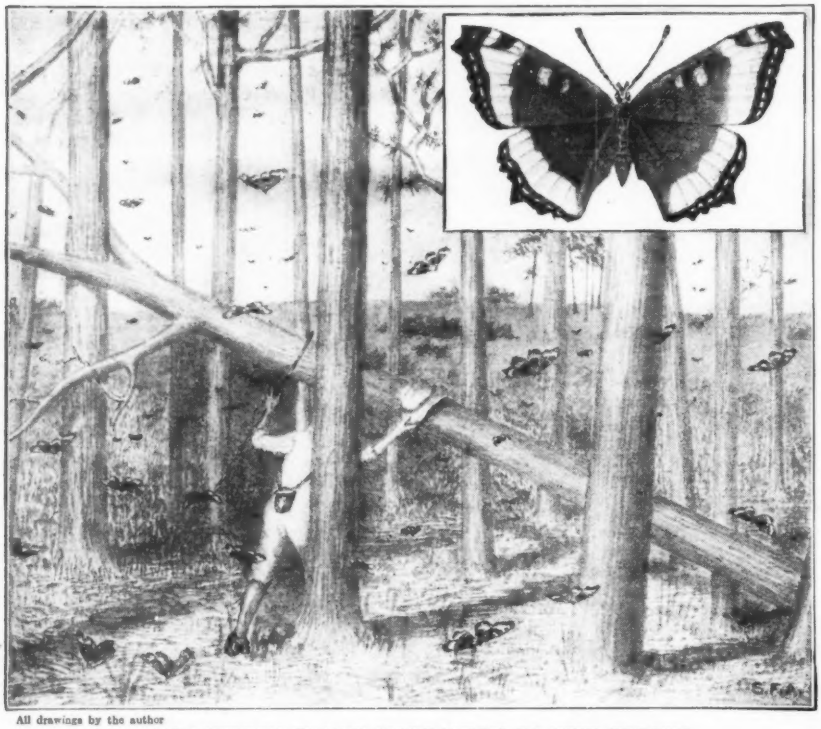
The eyes of the aged should be encouraged by the use of good light, suitable soft diet, and among other things the use of a reading device which is shown in the illustration. This device consists of a piece of black rubber six by four inches, in the center of which is a slit four inches long by one fourth of an inch wide. It is thin and light and can be easily moved down the page in reading, the aperture making clear all the print within its space.

This device lessens pupillary contraction, which is caused by a large white reflecting surface, gets rid of blurred secondary images and reduces irregular astigmatism, and spherical aberration. Like the mydriatic, this device sometimes makes reading possible for persons too ill or infirm for an operation, or renders an operation unnecessary. In other cases, it enables one to read until the cataract can be extracted. Nearsighted persons can use the slit without glasses; the farsighted persons can use their regular reading glasses in addition. The ordinary hand magnifying glass or the newer telescopic lenses may give added help.

Japanese Decoration for Scientific Investigations

IN the history of the progress of medical science, the Japanese hold a high place, due not only to the work of Hideyo Noguchi, martyr to discoveries in the field of yellow fever, but also to many other contributors who have done fundamental work in the field of bacteriology and of physiology. Recently the Japanese government developed a new decoration called in English "order of merit in culture" but in Japanese "*Bunko-Sho.*" This is conferred on all who distinguish themselves in literary work or art, or who achieve merit in connection with the progress of human culture and social welfare.

It is a significant fact that this decoration was conferred during the coronation of the emperor in November for the first time, and the two men on whom it was conferred were men who have done noteworthy work in the field of medicine. These were Doctor Shiga, co-discoverer with Simon Flexner of the bacillus responsible for causing infectious dysentery, and on Doctor Inada, who is credited with being the discoverer of the *spirochaeta icterohemorrhagica*, the organism associated with tremendous epidemics of infectious jaundice.



All drawings by the author

AN AUTUMN FLOCK MIGRATION IN NEW JERSEY

Witnessed among the pines of southern New Jersey in November, by the author who knocked a specimen down with his hat. It was Milbert's butterfly, *Vanessa milberti*

Why Do Insects Migrate?

More Controversy Than Knowledge Surrounds Their Mysterious Flights From North to South and Return

By S. F. AARON

THE migration of birds to meet the changing conditions of the seasons has given investigators about all that is known concerning the extension of flights, directions, topographic influences, and possible causes of those still somewhat mysterious winged journeys from clime to clime. There has been much controversy about the initial impulses that set birds in migration, and much remains to be learned regarding the routes and the winter resorts of many species.

The short and infrequent migrations of mammals result entirely from overcrowding, and this may also be said of certain reptiles. The ready trading of semi-tropical and tropical regions for those of the temperate zone, and vice versa, is very decidedly a job that may be undertaken only by wings, at least in coastal or level countries. Certain quadrupeds in high mountain sections, however, do make seasonal changes in altitude over short distances, mainly a matter of altitude.

So little attention has been given the subject of migration among insects that the investigator must rely, so far, almost entirely on his own observations. There are some data, but for the most part they appear to be woefully unsatisfactory, seeming to depend largely upon supposition, and may even be included in the class of nature faking—which term ought to be taboo among naturalists.

SIMPLY because certain species of insects have been seen congregating, later to disappear; and because large numbers of the same forms make their appearance still later in distant sections—is not sure proof of long migratory flights, although, of course, it is indicative.

The best evidence thus far obtainable concerning insect migrations is that of great numbers of a species making a southern flight in the autumn, and a corresponding northern flight in the spring, although this alone cannot determine the precise extent of these journeys. There seems to be lacking, also, information as to the district commonly visited for winter quarters.

In the Indian summer days of one early November, while in the forest not many miles inland from the southern New Jersey coast, I suddenly became aware of a vast number of medium-sized bright red butterflies around me, all of them flying in one general direction, pursuing a southwesterly course which at that point paralleled a distant inlet. For perhaps ten or fifteen minutes this flight continued, at the end of which the insects rapidly diminished in numbers. Not one of the little creatures paused or alighted for an instant, but I was enabled to strike one down with my hat and was astonished to find that the species was Milbert's anglewing, *Vanessa milberti*, the most southern summertime and breeding habitat of which in the lowlands is the New England States, although the species is found along the higher Alleghenies as far south as North Carolina.

I BELIEVE there is no previous record of this species ever having been taken within 200 miles of southern New Jersey during the warmer periods of the year. Where were these beautiful, swift little creatures going? I needed wings to find out, for theirs is the speed of a running horse. Was this flight only exceptional—a chance occasion? The only thing that could check the onward rush of these daring, fragile butterflies would be a lowered temperature, and that very thing occurred the following day; but even so they must have benefited, judging by the wintering habits of other and allied species.

On a late October day, within a mile of the eastern stretch of the Mason and Dixon line, I saw another medium-sized butterfly, *Vanessa j-album*, a species taken only by northern collectors and rarely found in the warmer seasons south of the Pennsylvania-New York line and southern New England, its breeding range being similar to that of its close relative, the *milberti*. This individual that had wandered so far south of its common habitat was well worn by travel, although exceedingly active; it would not have graced the cabinet of a collector, and judging by the way it dashed about the eaves of an old cabin, it evidently had no such intentions.

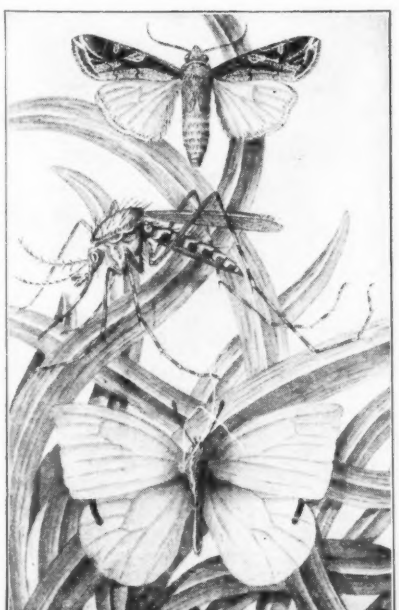
Eager to obtain the specimen for a locality label, and not having a net with me, I struck at the creature with my hat, but very naturally missed it and away it went, straight up the road toward the adjoining farm, as though it had previously investigated this section. There it hovered for a time about the barn and shortly disap-

peared, finding, I sincerely hope, a safe niche for the winter.

While cutting chunks for the fireplace from a fallen chestnut tree during January, in Delaware County, Pennsylvania, my axe split open a limb that had accommodated many large Cerambicid borers, the fat larvae of those gray, black, and brown beetles called longicorns. These borings had also been formerly occupied and widened by black ants, and later deserted. Almost having wedged itself into one of these, its wings crumpled by the effort, was a specimen of this *j-album* butterfly stowed snugly away for the winter and entirely inactive, for the weather was very cold. The insect soon revived when brought indoors. Again I may say that I believe there is no previous record of this insect being taken during the breeding season within 50 miles or more of the localities above mentioned.

A QUESTION was raised by these experiences that chiefly rests upon conjecture. If these butterflies journey to slightly milder climes for hibernation, what do they gain by it? There is not a very great difference in actual degrees of temperature—perhaps at best a matter of 15 degrees in the extreme. And it has long been ascertained that insects of temperate regions, when still vitally active, their natural functions not having been impaired, can survive almost any degree of cold.

It also is worth noting that following severe winters the insect life is generally more abundant than when an open mild winter has given the numerous enemies greater opportunity to pry into hiding places and shelters. Again, it is found that frequent thawings and freezings are much more likely to be fatal to all insect life than continuous cold. Why, then, the long journeys of a hundred miles or more to find conditions that are not more favorable?



NOTABLE INSECT MIGRANTS

Fall army worm moth (top); common salt marsh mosquito; *Kricogonia* butterfly

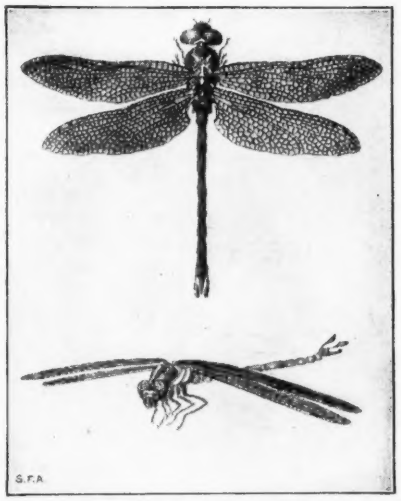
As a young collector in eastern Tennessee I not only became familiar with the butterfly fauna in general, but I knew also the local habitats of most species. On rare occasions we took specimens that were distinctly northern in their range, although these may have come down to us from the higher ridges of the Big Smoky Mountains, possibly by mere chance, just as some southern forms ranged up from the Gulf coast. It did seem odd, however, that nearly always the former were taken in the autumn, as though the insects had sought a close-by warm section in which to hibernate. Two of these were the anglewings, *Grapta faunus* and *G. gracilis;* another was the wood nymph *Satyrus alope* variety *nephele*, which latter rarely, if ever, has been known to hibernate, although it occurs late enough in the season to make use of the habit.

It would seem almost like sacrilege to dwell upon this subject at all without mentioning the great monarch butterfly, the gregarious habit of which is too well known to need description.

IT has been asserted that this insect travels by wing hundreds of miles, even reaching sections where it cannot multiply because of the absence of its food plant, the milkweed. The wing power of the species is well known and clouds of the insects have been seen far out at sea, but I think it doubtful that its inhabiting of far countries has depended upon its flight; nor am I ready to believe that its migrations in our own country are proved to be very extensive.

In southern Delaware I witnessed the arrival of a swarm of these butterflies about or soon after the time that they were commonly swarming in sections a hundred miles or so north of the spot. They came on like a great swirling cloud, settled upon everything and gradually dispersed. My note-book records the date as October 14th, a little after 11 A.M., a mild, sunshiny day. For an hour or more the air was full of red wings going in every direction, but time prevented tracing any individuals to their roosting places, as the day approached its end. A visit to the locality the following day showed an abundance of the butterflies with no apparent attempt to swarm again, and it is very doubtful if they did so.

From the conditions of the specimens captured and observed closely it was evident that they had not flown far. But why should they? Nature generally works along in the course of least resistance, and although swarms of the monarch have been seen at sea, they were the victims of contrary winds.



THE AIRPLANE INSECT

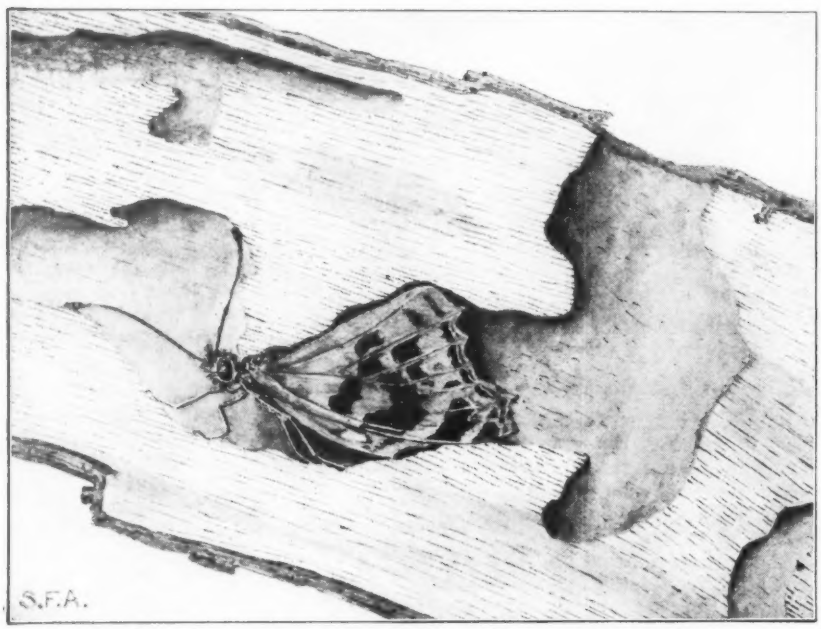
An *Aeschna* dragon fly. These most graceful winged hexipods are regular migrants

That there is a tendency on the part of some insects to journey for the winter into localities that are sunnier and warmer there can be little question. This, to my knowledge, applies to one butterfly and two dragonflies. It may safely be asserted that the habit of migration is exceptional among insects; almost all species either hibernate in the adult form, where they breed, and these are in the minority, or they die, depending for the continuation of the species upon the sheltered, immatured stages which can always resist cold.

IN the lower counties of Texas, throughout the pastured areas and those of the cactus and ever-flowering lantana, the chief representative of the sub-family *Pierinae*, with the exception of the sulfurs, may be known only by its scientific name, *Kricogonia lyside*. It is a medium-sized, buff-white butterfly with very few markings and swift on the wing. During the heated period of the spring rainy season and the summer droughts this insect is by no means common throughout the area along the Rio Grande, although I confess I do not know where it is found at that time in numbers. At or near the end of the dry season, along in September or a little later, the prairies from the Guadalupe River valley southward teem with countless numbers of these butterflies, all flying directly from the north and toward the south, many of them going far into Mexico. After this time, throughout the area mentioned, the species is very common. In April or early May another flight takes place, although in

vastly reduced numbers and the direction is entirely northerly. Where they go, however, is yet to be determined.

I had the delightful experience of witnessing these migrations of *Kricogonia*. That of the fall period could not but draw exclamations of wonder even from persons indifferent to creatures of minute proportions. Close to the ground and as high in the air as the eye could detect such pale glinting things, the butterflies passed on, never stopping to visit the many honeyed flowers on their way. But upon reaching the region within 100 miles of the lower Rio Grande, there was probably a quick dispersal, for, traveling through that section a little later, we found them in large numbers going about their business of seeking sweets, commonly from the freshly dampened earth.



A NORTHERN BUTTERFLY HIBERNATING FARTHER SOUTH

The retreat depicted in the author's drawing is a beetle larva boring in a dead tree limb. The butterfly is probably about two hundred miles south of its regular summer habitat

NOT the least interesting among winged insects capable of prolonged flight are the dragonflies, especially those larger and more powerful forms that are built remarkably close to the lines of a modern airplane, lacking, of course, the same kind of motor. These are, in fact, typical biplanes of the pursuit type, the forward wings being above and considerably ahead of the lower pair, with all four working independently of each other, although generally in unison.

Dragonflies are not, despite fanciful statements to the contrary, the swiftest of insects, but they are surely the easiest and most graceful on the wing and capable of the most sustained flight, being constructed in this respect with incomparable regard to relative muscle and wing expanse. That these masters of the air should have formed, through long inherited inclinations, the habit of keeping ahead of inclement weather is no more surprising than that the swallows should do the same. Insects and other cold-blooded creatures are far more susceptible to slight changes of temperature than those of warm blood, and it may be observed, although with some difficulty, that these tireless, swift-winged, diurnal species which nearly emulate the nocturnal bats, often tend in their wanderings to progress toward the sun as it lowers toward the winter solstice. Thus I have seen, during a day afield in October, many hundreds of these largest dragonflies, known as *Aeschna*, and particularly the common species *furcilata*, all flying southward and pursuing nearly the same course in general, on the way taking many unwary insects in the air. A little earlier, until late September throughout southern Pennsylvania, these insects are still skimming about. It may be observed also that some of these large *Odonata* remain in colder climes, attempting to hibernate in dense bunches of leaves, although it is doubtful if many survive, because of the diligent winter birds.

I witnessed one extensive migration of *Aeschna furcilata* in the prairie country. These insects are never noticeably gregarious, and that so many were performing the journey at the same time was due entirely to a common impulse, no doubt influenced entirely by the changing temperature. We were traveling by wagon team due west; we found the big dragonflies heading straight south, continually coming on to the right, going on our left, never high in the air, never mixing nor flying close together, but in any direction our eyes could take in hundreds. As with the *Kricogonia* butterfly, there were countless millions, but unlike the butterfly the migration continued not only during the hours of brighter daylight, but toward dusk.

I have suspected some other dragonflies of the migratory habit, a species of *Cordulia* and the great *Tramea basalis*. Other winged insects show the migratory instinct—not confusing this with the swarming nor with the marriage flights of several species. Some are not at all understood: for example, the late summer swarming of the mosquito *Culex iritans*, northerly along the coast, out to sea or in any direction. This may be a hereditary instinct not well developed.

QUITE different is that of the well-known salt marsh mosquito, *Aedes sollicitans*, by far the most plentiful of all *Culicidae*. This insect breeds only in brackish water, yet countless numbers of them from Canada to Central America regularly migrate inland many miles in order to obtain food, and almost as regularly return to deposit their eggs. These flights are commonly distributed; sometimes, however, the insects are *en masse*, forming vast clouds that have given rise to the statement that they darken the sun. This is rather an exaggeration, as the flights generally occur at night, although the insects are active at all times.

Many of the experts have given the greatest distance of these flights as 25 miles, observed in New Jersey and the Florida everglades. In southern Texas the writer has taken specimens more than 70 miles inland from the coastal salt water and at least 50 miles from the nearest brackish water, although the mosquitos were not plentiful.

Another common insect migrant is the moth of the well-known and pestiferous fall army worm, *Laphymga frugiperda*, a southern species with an apparent tendency to journey north, these flights being inspired by the desire to find abundant and fresh food plants. Often several hundred miles are thus covered by these strong-winged noctuids, flying in large numbers at night and with the same objective, as shown by the vast number of eggs being laid over a relatively small area and the consequent injury by the resulting caterpillars. From time to to time the bright lights in our city streets have interfered with and checked these migrations, to the discomfort of pedestrians, but in many cases no doubt resulting in the destruction of thousands of moths and a consequent very material lessening of the worms in the fields beyond.

Safety for Those Who Go Down to the Sea in Ships

THE winter just past has, without doubt, been one of the worst in many years in the age-old story of the sea. The Atlantic has been particularly boisterous, has claimed several ships and many lives. It has been the scene of disaster and peril, of despair and heroism, of losing fights and triumphs over its relentless fury.

Following the focusing of public attention on the problems of the sea by the loss of over a hundred lives when the *Vestris* foundered, other ships sank or passed through periods of great danger. Even on the luxurious *Majestic*, a life was lost and the great ship itself was damaged when a mountainous wave swept over it. The climax of the winter's series of battles with the sea came with the news of the rescue of the entire crew of the Italian freighter *Florida* by courageous Captain Fried and his crew on the steamer *America*. Nothing can detract from the glory of this thrilling rescue on the storm-tossed high seas; the brave attempt was successful not because of efficient equipment but principally because of the fact that the rescuers were iron-nerved and fearless.

In view of these facts, shipping interests throughout the world are acclaiming the efforts of those who are studying the problem of safety at sea. Thus, SCIENTIFIC AMERICAN'S announcement of a gold medal to be given in 1929 for sea safety devices or equipment has aroused the interest of thousands and already a number have signified their intention of participating in the competition. All the details of this competition have now been worked out and the committee of judges is complete.

THE conditions of the SCIENTIFIC AMERICAN Gold Medal for 1929, to be awarded by the American Museum of Safety, supplementary to, and amending the announcement in the February and March, 1929, issues of SCIENTIFIC AMERICAN, are as follows:

(a) The devices, apparatus, designs, or constructions submitted must have been developed or improved upon since the last International Conference for Safety of Life at Sea (1913).

(b) They must be self-contained on the ship, or an integral part of the ship.

(c) The Committee will give special consideration to the practicability and economic application and operation of the devices, apparatus, et cetera.

(d) An important factor of any device, design, et cetera, would be the practicability and feasibility thereof—the decision as to both to rest entirely with Committee.

(e) Preferential consideration will be accorded to apparatus available for simple manual operation, in addition to any power operation of above; or aided by such resources as would be available on board at all times; such as electrical apparatus operated by current from storage batteries also.

(f) All applications must reach the office of the American Museum of Safety, 141 East 29th Street, New York City, by September 30, 1929. No models should be sent unless requested by the Committee.

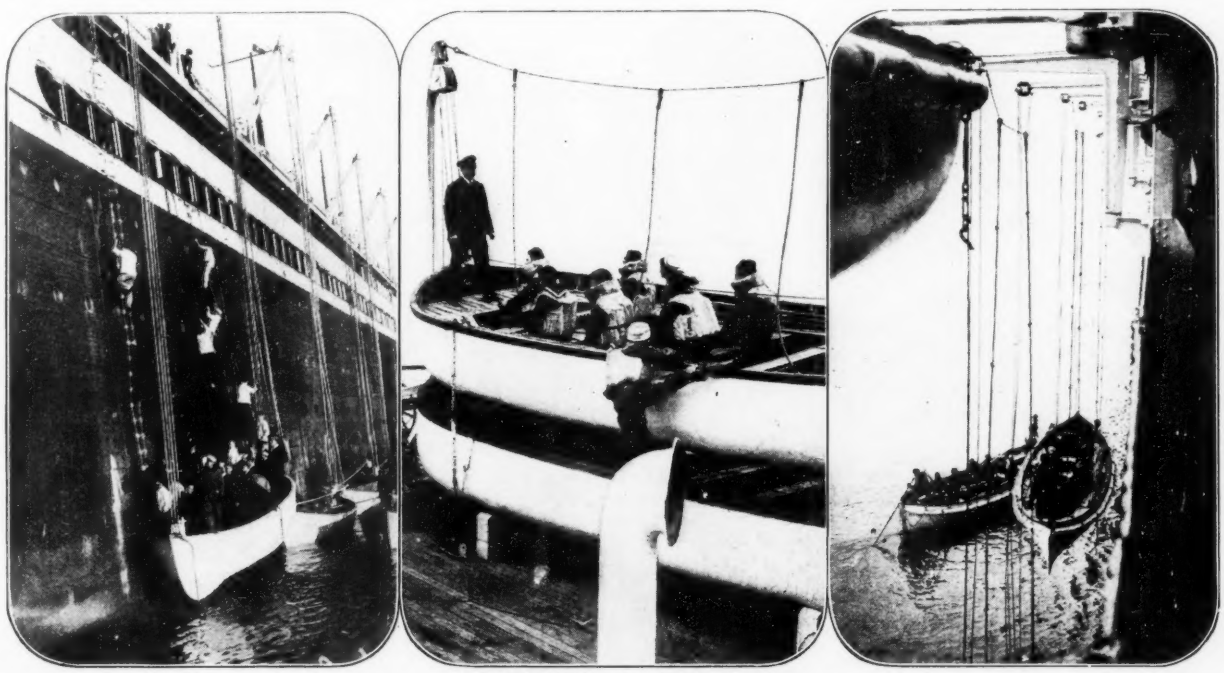
The committee consists of the following:

Chairman
Rear-Admiral C. McR. Winslow

Vice-Chairman
Capt. E. T. Fitzgerald

Rear-Admiral W. S. Benson
H. H. Brown
Captain T. H. Lyon
Captain C. A. McAllister
Captain H. McConkey
A. B. Newell
Rear-Admiral C. P. Plunkett
Captain F. Riesenberg
L. Weickum

Ex-Officio
A. A. Hopkins, Director
J. F. Parker, Secretary



FOR GREATER SAFETY AT SEA

It is vitally important that life boat drills be practiced regularly on all ships but the crews of larger passenger-carrying steamers should be letter-perfect in these drills. At the left is shown the *S. S. America*, and center and right the *Leviathan*, carrying out life-boat drills

Paper Milk "Bottles"

An Improvement in Milk Distribution Which May Revolutionize a Vast Industry

THE PAPER "BOTTLE"

The milk bottle and the milk wagon are endangered by this new paper container

A NUMBER of years ago the SCIENTIFIC AMERICAN made a broad canvass of representative sanitarians, heads of boards of health, et cetera, relative to the hygienic position of the glass milk bottle, but at that time very little progress had been made on a paper container, and things ran along as usual and the big milk companies had to put in larger and larger bottle washing machines and the bottle making firms added more furnaces. Now, however, after a long period of incubation the paper milk bottle emerges from obscurity and bids fair to put both the glass milk bottle and the time-honored milk wagon itself out of business.

The combined dairy industry produces food products of prime necessity with a total annual value of five billion dollars—greater than the entire output of the motor car industry—greater than the entire output of the steel industry—greater than the combined annual value of the cotton, wheat, and potato crops.

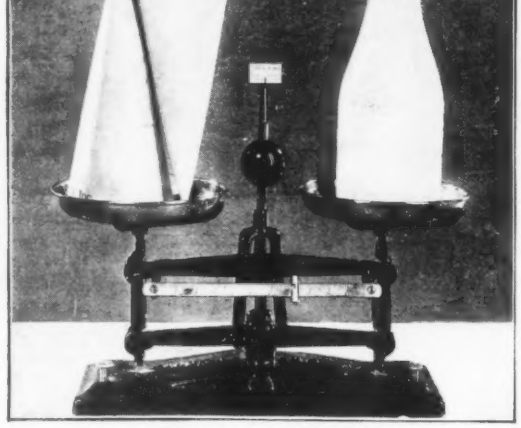
During the last 40 years, progressive milk distributors, aided by the medical fraternity and sanitary authorities, have made vast capital investments to improve methods and have built and equipped the best possible plants to handle milk under the most ideal conditions money, skill, and science could provide. Dairy inspection, milk inspection, pasteurization, grading, certification, glass lined tanks, refrigerator tank cars, all have been adopted at great expense to protect the purity of milk and make its safety equal its importance as a food. Despite all this effort, little progress has been made until now in the actual packing and delivery of milk to the consumer.

THE introduction of the glass bottle 40 years ago was a long step forward from those days when the milkman filled from an open can the pitcher or pail left at night on the doorstep, but the glass bottle with easily removable paper cap admittedly has proved unsatisfactory and has never rounded out the perfect milk service.

One of the largest dairy concerns operating in New York has already installed facilities for making 50,000 quart paper containers a day, as the installation of the first unit. The new container has been received with considerable applause by the newspapers and the consumers and wide publicity has been given to the advent of the "Sealcone" as it is called. The new container is cone-shaped and is made out of spruce fiber which is subse-

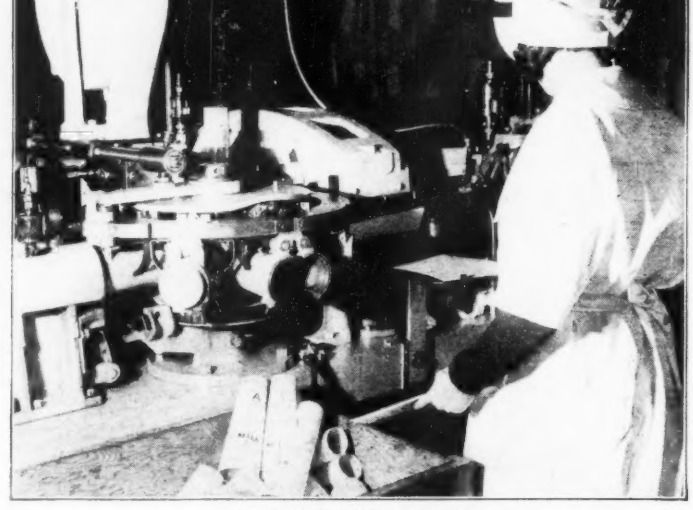
THE NEW SPACE SAVER

To the left are Sealcone cartons, holding 24 quarts of milk. To the right is a case with only 12 glass bottles



TWICE AS MUCH MILK

Weight is a great factor in milk delivery. On this scale are two quarts of milk in the new sealed containers in the left hand scale pan, while on the right is a filled glass quart milk bottle. Two of the new containers filled with milk weigh only seven ounces more than the quart in glass—68 ounces as compared with 60.4 ounces. The saving in transportation is apparent

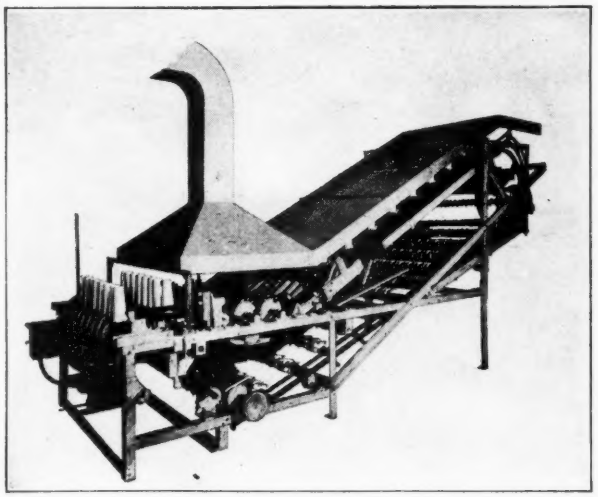


FORMING THE CONES

This machine makes the cone-shaped tubes from blanks and fits in a circular disk which is tightly "spun" in to make a solid impermeable bottom

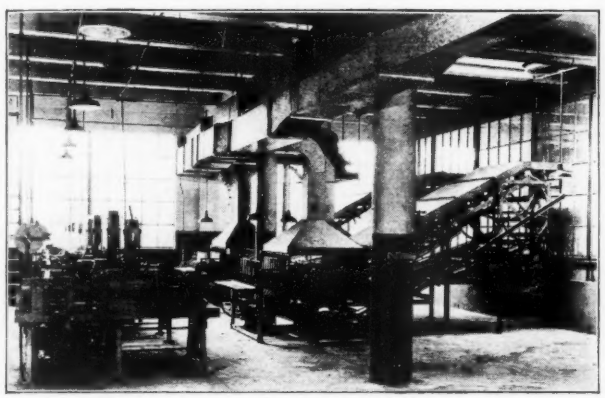
quently paraffined. It is light in weight (one and one half ounces) and is leakproof and airtight. It is as durable as is required, for it is thrown away after the milk is used. It is sealed very positively and cannot be tampered with. The date of pasteurization is stamped on the seal.

The new container brings to the consumer fresh sweet milk in a completely sterile condition. It has been found that this paper cone keeps milk sweet longer than any other kind of container. The Sealcones eliminate all washing of bottles—always an expensive operation. It also does away with freight on bottles from the factory to the bottling plant and the picking up of "empties" by the milkman. Glass bottles are fairly expensive and, in the case of stores, a deposit is usually exacted from the customers.



STERILIZING

The new milk container is sterilized, after fabrication, by running through a bath of hot paraffine, and it is then chilled by washed cold air. The Sealcones emerge leakproof and sterile ready for the fresh milk



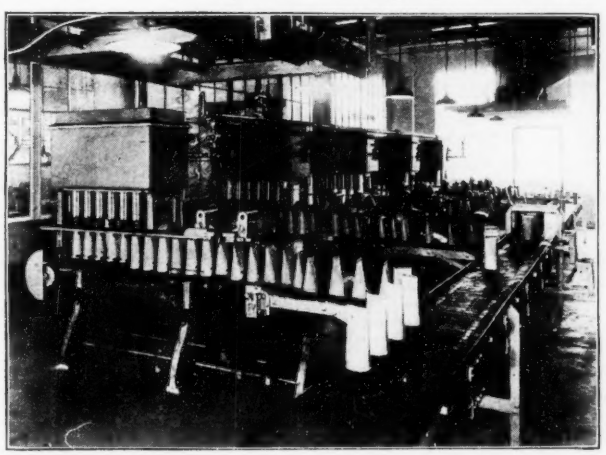
MAKING

Here is seen an actual installation, in New York City, of the machinery for making and sterilizing Sealcones. The equipment illustrated has a capacity of fifty thousand new containers in eight hours

The paper containers can be filled with milk at a temperature of 33 to 35 degrees, Fahrenheit. This is far below the point at which bacteria begin to flourish (40 to 45 degrees, Fahrenheit) so that the milk is sealed in a sterile condition. Milk in Sealcones has been kept, of course under proper conditions, for long periods. Dr. L. I. Harris, former Commissioner of Health of New York City, says that the growth of bacteria would be slower in the cardboard than in the glass. He also hopes that the milk companies will reduce the cost of its product to the public so that containers will be within the financial reach of those who now use loose milk. Of course, the companies must have time to write off the old washing machines before any tangible reduction could be expected.

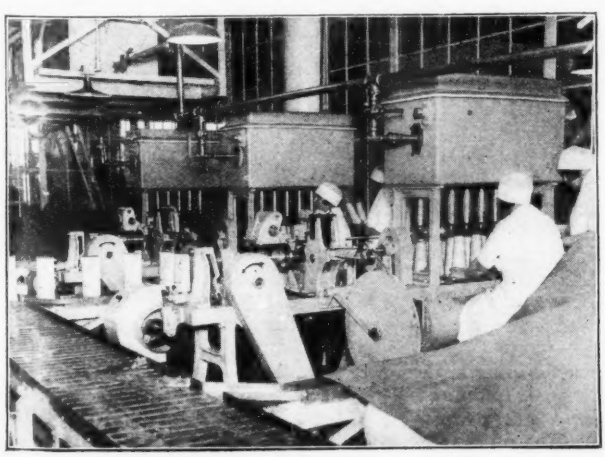
The new container can be opened quite simply by cutting off the narrow end of the cone—a scissors will do. Compare this to pushing in a milk bottle cap. Instructions are printed on each container.

If the glass bottle goes, it is quite likely that the old milk wagon will disappear for the company which has supplied the container is also manufacturing a carrier built on a motorcycle sidecar chassis which carries 360 quarts of milk, 60 quarts more than the average glass load.



FILLING

Here the newly manufactured Sealcones are filled with milk, sealed, and stamped with the date. All these operations are performed automatically and hygienically. The seal is airtight and cannot be used over again



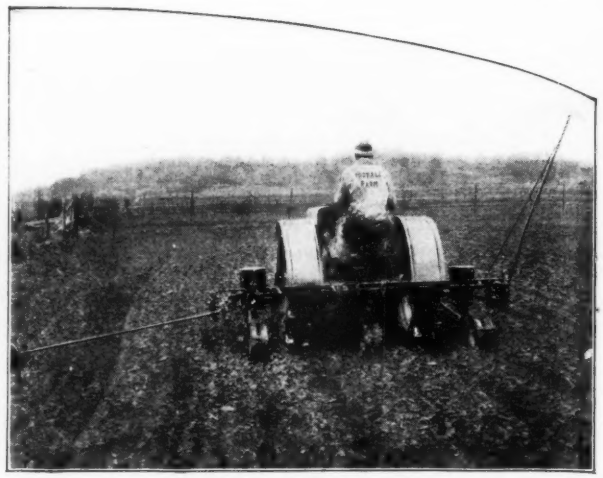
SEALING

The rust-proof metal seal prevents tampering with the contents. The seal itself does not come in contact with the milk. The date of pasteurization is automatically stamped on the metal seal of the container

Our illustrations with their captions fully describe the various processes. The paper is die-cut to the proper size. The machinery comprises one continuous process and the equipment is divided into three units, all of which are shown. They are: the forming machine, the paraffining machine and the filling and sealing machine. Such, in brief, is a solution of the problem of modern milk sanitation and efficient distribution.

THREE-ROW CORN PLANTER

This labor-saving machine plants at a uniform depth. By means of differential brakes it can be turned around squarely at the end of the row, this feature making it useful on small fields



30 TO 40 ACRES A DAY

View of another three-row corn planter with which one man can plant in one day several times as many acres as a man with a team of horses. Seed containers may be seen before the following wheels

Making the Farm Pay

A Practical Farmer Gives, From His Experience, Some Rules For Running a Farm Scientifically

By FRANK M. BYERS

IN industry there are certain economic laws which govern profit. Accounting records on farms also, show that there are economic laws and accepted methods of procedure which influence profit in agriculture. Briefly stated, the factors which make for efficient farming are as follows: Large crop yields; Growing valuable crops; Amount of live-stock; Efficient live-stock; Efficient feeding of live stock; Large volume of business; Efficient use of man labor; Fitting power to farm needs; Minimum building and equipment costs; Efficient field and building arrangement; Diversity of production; Improved quality and better price; Farm budgeting; Farm bookkeeping.

IT is apparent that large yields per acre reduce the cost of producing a bushel or a ton of farm crops. Expenses of production remain fairly constant regardless of the yield, so that any yield secured over that required to pay expenses is clear profit.

While it is easily possible to be inefficient in the disposal of crops, yet I believe that the ability of the land to produce large yields is the first requisite of a profitable farm. In other words, those soils which, because of drainage or other physical conditions, can never be made to produce large yields, will always be a handicap to successful general farming. On such land, however, it is often possible to conduct poultry, orchard, or fur enterprises.

Large crop yields per acre are essential and also total crop yields per farm, which means that a large percentage of the farm must be tillable. The things that can be done to increase crop yields are: Use varieties and strains of seed which experiment stations prove to be high-yielding and of high quality; Use seed of high germination test; Use seed free from disease; Plant at the right time; Grow alfalfa, clover, or other legumes; Use all available manure; Use limestone and fertilizers as recommended by experiment stations; Be thorough in tillage and cultivation; And employ proper drainage.

Not only should valuable crops be grown, but the greater the acreage of these crops, the greater the income. For the corn belt, the most valuable crops are corn and wheat, alfalfa as the hay crop, and sweet clover as the pasture crop on tillable land. On tillable soil, the least valuable crops are oats, timothy hay, and blue grass pasture. It is quite evident that a per acre yield of four tons of alfalfa hay worth 20 dollars per ton is more valuable than two tons of timothy hay worth 15 dollars per ton.

WE can go back to the ancient Roman writer, Columella, for advice on alfalfa, for about this wonderful plant he wrote 2000 years ago:

"Of all the legumes, alfalfa is the best, because, when once it is sown, it lasts 10 years; because it can be mowed four times, or even six times a year; because it improves the soil; because all lean cattle grow fat by feeding upon it; because it is a remedy for sick beasts; because a jugerum (two thirds of an acre) of it will feed three horses plentifully for a year."

Over a period of years those farms

The Farmer's Hope

FARMING is one of the oldest human industries, and probably because of this very fact it has, in many instances, changed but little as the years have rolled by. How can the farmer increase his profits? That is the question that many agriculturists are asking. The answer is at hand, if they will but heed the lessons taught by the younger industries. Increase crop yields per acre; make efficient use of live-stock; employ intelligently the excellent farming machinery that is available today; keep records that will point out the weak spots so that they may be eliminated. These and other points are forcibly brought out in the accompanying article written by a practical farmer who is making his farm pay.—*The Editor.*

which have the largest investment in live-stock have the best chance of profit. All other things being equal, it is usually possible to get a better price for farm crops when marketed in the form of living stock or live-stock products than when sold off the farm.

Except where there is a preferred market, it is not advisable to keep more live-stock than can be fed with the feed grown on the farm, for when feed must be purchased, freight charges must be added, and also a greater degree of chance is brought into the business, due to uncertain markets, and the necessity of a cash outlay for the purchase of feeds.

Probably the most important factor in successful live-stock farming is the ability of the live-stock to utilize feed in the production of meat or other products. It is essential that the live-stock be well-bred and free from disease. Young stock should be well-fed for proper growth.

THREE-ROW TRACTOR CULTIVATOR

With this, one man can cultivate 25 to 40 acres a day. Rigs are lifted, for turning at end of row, by a power take-off. Cultivator shovels follow wheels to obliterate wheel marks

IN the case of dairy cows, only those which are economical milk producers should be retained in the herd. The services of a Cow Testing Association are valuable in determining which cows should be weeded out and sold for beef.

Efficient feeding requires a knowledge of the proper mixing of feed rations as to protein and carbohydrate content. The feeder should know the percentage of various elements in feeds, and if he does not know how to balance rations, he can get help from his state experiment station or from farm papers. Protein is the most expensive feed and, since the legumes are rich in protein, the feeder will do well to grow a large acreage of sweet clover or other legume pasture, andalfalfa, soy-beans,orclover for legume hay. Live-stock will consume considerable roughage and feed which cannot be sold on the market at a price which will show a profit.

The goal of the feeder should be to secure the greatest return possible in live-stock products for every 100 dollars worth of feed consumed.

We have heard about the man who had such a large volume of business that he was able to sell below cost. While obviously not true, yet there is an advantage in large volume in farming as in any other business. The largest possible income per acre, and the greatest number of acres that can be operated under the system of management that is selected, promotes efficiency, but studies so far do not indicate that with diversified live-stock farming, there is any increased efficiency in favor of exceptionally large acreages. On farms devoted exclusively to grain raising, it is probable that much larger acreages can be economically operated. The problem of area is now being studied by engineers and economists, and the next few years should bring forth valuable information.

Dairying, hog-raising, and poultry production are the best enterprises for providing a larger volume of business without adding to the size of the farm.

The most successful farmers usually work a large number of acres per man, without reducing the yield of crops. In the corn belt the best farmers till about 90 acres of crops per man on live-stock farms. On some farms, it is doubtless possible for one man to tend a greater acreage, especially where the new general purpose tractors are used, with their larger equipment such as three-row planters and cultivators.

THE physical properties of the soil and the contour of the land have some influence on the efficiency of machines and power which in turn influences the number of acres that can be operated per man. It is possible, for one man to till the greatest acreage on grain farms. Since large yields per acre are essential to profit, there would be no advantage in increasing the acreage per man if less careful work resulted in lower crop yields.

It is possible to plan a rotation of crops that will distribute the labor throughout the season. In the case of corn and alfalfa, which are two of our most profitable crops, we have a labor conflict, especially at the time of harvesting the first alfalfa crop, but if it is possible to hire labor for a few days, it is profitable to do so, rather than to reduce the acreage of these two crops.

Raising live-stock helps to distribute labor throughout the winter. One of the economic problems of agriculture is the seasonal nature of the enterprises, and the inability to have continuous productive work all the months in the year is one that requires much study.

NO FARM RELIEF NEEDED HERE

The author standing in the edge of a cornfield on the farm which he manages. The stick he holds is marked off in half-foot spaces to indicate the height of scientifically grown corn

CUTTING THE WONDER CROP

Using a tractor mower to cut alfalfa. The mower is driven by power take-off from the tractor. This outfit can also be equipped with a side-delivery rake for clearing path for next round of the tractor in order that the hay already cut will not be matted by the wheels

It is necessary to keep the power and machinery costs per acre at a minimum. That horse labor is one of the major costs, often exceeding the cost of man labor per acre, is a fact not generally known to farmers. The feed that horses eat is usually raised on the farm and, for that reason, the cost of keeping horses is under-estimated. The extra horses that are kept to carry the peak loads of planting and harvest can, in many cases, be economically replaced with tractors. The writer replaced one team, used to hoist hay, with a three-drum hay hoist driven by a five-horse-power electric motor. This hoist has been used for 10 years and is more convenient and efficient than horses. The electric motor is also used to grind feed.

THE investment in power and equipment should be sufficient to do the work properly. Any excess, will, of course, cause loss.

The application of power to farm work is a subject which is now being studied by agricultural engineers. New machines and methods which will have tremendous effect on the future of agriculture, especially in crop production, are in process of development. Since live-stock production consists chiefly of breeding, raising young, feeding, and disposing of manure, it is evident that it is very difficult to apply labor-saving machines, especially power machines, to these enterprises.

The farmer can economize by keeping machinery properly housed, lubricated, and repaired, and by keeping only as many horses as are needed and feeding them according to the work done.

It is a fairly well established rule that, in the end, all expenses must fall on the land. Since unproductive acres are not able to bear any expense, all of the expense of developments or changes must go to the productive acres.

Another rather fixed rule, previously mentioned, is that usually it is unwise to keep greater numbers of live-stock than can be fed with the feeds grown on the farm. Roughly classified, there are three classes of land; That upon which cultivated crops can be grown; That which will grow pasture grasses; That which is unfit for either of the first two.

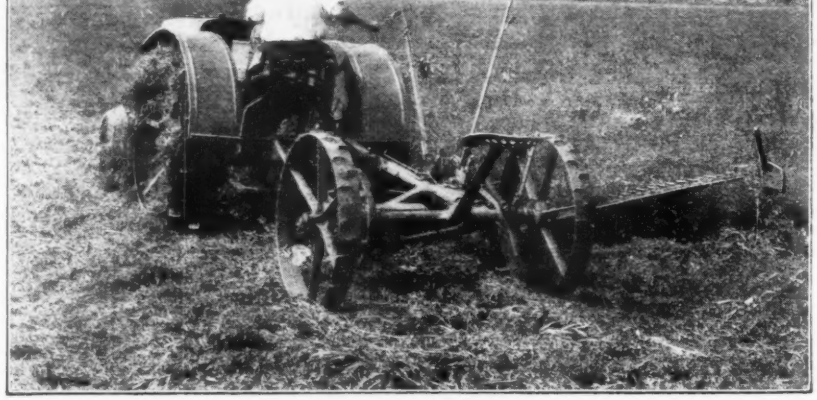
It is safe to say that the amount of live-stock is very definitely fixed by the number of tillable acres; a possible exception is poultry or some such special enterprise.

Therefore, since the amount of live-stock is limited by available feed, the investment in buildings is automatically regulated by the amount of live-stock to be housed. It is desirable to have a minimum building cost per animal. Any unused or unnecessary buildings are a useless burden upon the live-stock which must bear the building expense. It is an advantage to have a large acreage of tillable land over which the building cost can be spread. Building repairs and maintenance should be done with farm labor when other work is not pressing.

The farmer would do well to study some of the labor and time-saving methods that are the result of factory planning. Any arrangement of fields and buildings that calls for excessive idle movement of men, horses, and machinery is not economical. An average distance of 99 miles a month was walked to feed and care for the live stock during the winter season on a group of farms in Putnam County, Ohio. The range walked monthly per animal unit fed and cared for, was from 3.7 miles to 11.4 miles.

LARGE fields to permit continuous operation of machines without turning, with fields as near as possible to the farmstead is the ideal arrangement. Obviously, there is a limit to the distance between fields and buildings for the economical hauling in of crops and the hauling out of manure. The square farm would have an advantage over the same area spread out in a long narrow strip.

The arrangement of buildings and yards should be planned in advance of any construction work, and the plan should provide a location for any future buildings. Consideration should be given to distance of travel between buildings for man and horse, to access to buildings and bins with wagons, trucks, and manure spreaders, and to convenience in getting feed to live-stock and manure and litter away from them. Exercise lots should be adjacent to that part of the building



TRAILING A MOWER

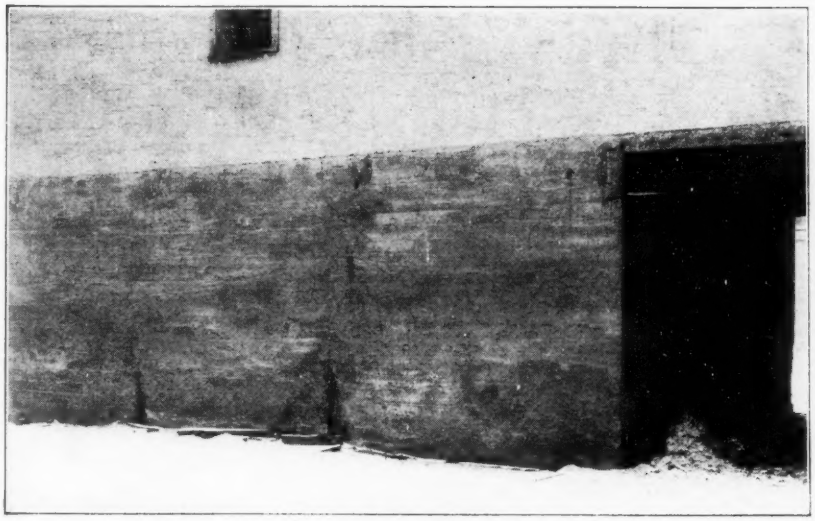
This photograph shows how a general purpose tractor may be used to operate old style equipment: a six-foot mower which takes its power from mower wheels, drawn by a tractor

which houses all of the farm animals.

There are many pieces of equipment such as overhead carriers, corn elevators and push trucks, which will save labor.

Fields and lots should be planned to use a minimum of fence, with permanent fences only where necessary.

During the past few years, those farms devoted chiefly to the production of grain have, as a rule, operated with a loss, with the exception of the wheat farms of the Northwest which are now in a prosperous condition. The low prices of grains are partly responsible for this. On the live-stock farm, there is a supply of manure, which helps to maintain soil fertility, while in the absence of manure on grain farms, there is a tendency to neglect the maintainance of fertility, with a resulting decrease in crop yields. Also, on live-stock farms there is usually a greater acreage of legumes grown which adds directly to the income, because they are high-profit crops, and, indirectly, because legumes benefit the soil for future crops.



AN EXAMPLE OF POOR PLANNING

This manure pit which is 30 feet long has only the one opening at one end. In loading a spreader, manure has to be carried by hand 30 feet to the door, when pit is nearly empty

DIVERSITY of crop production provides some protection against crop failure; distributes use of labor, power, and equipment; and controls plant diseases, insects, and weeds.

While some successful farms receive a large part of their income from one or two sources, yet diversity of income is generally desirable. It is apparent that if additional enterprises are successfully operated, they not only add to the total income and profit, but also bear a portion of the overhead expense.

It is a mistake to attribute too much importance to the factor of improved quality. While it is possible to secure somewhat better prices through improvement in quality, yet the increase in income is not so large as is generally believed. Those farmers adjacent to retail markets, where a premium is paid for quality, are only a small percentage of the total number of farmers.

There are locations where farmers can take advantage of quality markets for poultry and dairy products, and even stimulate these markets by proper advertising. Better prices can be secured by growing varieties of crops that mature early and have the chemical and physical characteristics desired by the market. Planting at the proper time on fertile soil, combating disease, and protection at harvest time, all have an influence on quality.

It is possible to feed live-stock so that it will be ready for market when prices are most favorable.

A farm budget will be helpful in planning future work. It should show the crops to be grown, the live-stock to be kept, and the estimated production, receipts, and expenses from the various sources. The budget is the business-like way to work out and record farm plans.

By means of a budget it is possible to compare the returns that may be expected from different systems of farming. In this way costly errors may be avoided. Budgets anticipate needed supplies such as seed, fertilizer, feed, and machinery.

The average farm represents a value of perhaps 25,000 to 50,000 dollars or more. With such a capital investment, it is necessary, from the standpoint of good business practice, to keep a set of books. The farm accounts should show in some detail the receipts and expenses. A complete record of the crops and other produce raised is desirable. An inventory of all feed and live-stock should be taken at the end of the year. It is doubtful if cost-accounting is necessary or practical, except in special cases.

FAST WORK

Cutting a 12-foot strip of alfalfa with two mowers trailed behind a tractor. Although some trouble was experienced in turning with this outfit, it proved to be an efficient, fast rig

MOST farmers can get help in farm accounting work from their county agents and agricultural colleges.

Farmers who are now successful are usually men of exceptional education who are capable managers. Men of similar ability in the industry world would receive much greater incomes.

Successful farmers have often spent years in improving their soil, developing efficient herds of live-stock, and in equipping their farms for economical operation. Some improvements can be made rather rapidly, while others, such as making the soil and herds more productive, may take several years. Even though it takes time to get results, the effort is not only justified, but is essential to complete success in the effort to increase the income from the farm.

Ultra-Violet Transmitting Glass—Has It Made Good?

Observations on the Physics and Physiology of Special Window Glass for Transmitting Indoors Part of the Vital Ultra-Violet Rays of the Sun, Based on the Opinions of Foremost Scientific Authorities

By ALBERT G. INGALLS
Associate Editor

IS THE new ultra-violet transmitting window glass making good? Is the home of the future—the school, the office, and the factory—to be equipped as a matter of course with this newly available kind of glass, or is it only a passing fad?

Questions of this kind are frequently received by the SCIENTIFIC AMERICAN. They come from people who have considered purchasing this glass—from owners of homes, especially the parents of infants and growing children; from members of school boards who wonder what decision to make where the installation of the glass in school room windows has been under discussion; from the directors of hospitals and sanitariums who wonder whether its installation would soundly justify the extra expense; from the heads of industries who are trying to decide whether employees in office or factory would lose less working time because of colds and sickness and possibly show more "pep" in their work if placed behind ultra-violet transmitting glass; and from other people, difficult to classify, who merely want to know.

AT the present time no simple, clean-cut, unqualified answer of the "yes" or "no" type can be given to these questions. The science of outdoor sun therapy is young, and that of sun therapy through ultra-violet transmitting glass is younger. Although some of the best physicists are daily performing research on this kind of glass, and many of the ablest specialists among physicians are as constantly watching its biological effects on man and animals, much still remains to be learned. A large part of the statements to be obtained from scientific authorities must as yet be in the nature of opinions, not dogmas.

Certain conclusions, however, already begin to emerge. Of these the broadest is, that ultra-violet transmitting glass is doubtless destined to have a permanent future for health purposes, but that its usefulness is likely to be more limited than some of its more enthusiastic proponents now think. To overdo the claims for its benefits will, it is thought, do the glass lasting injury. If too high expectations are engendered, they cannot be made good; a reaction may follow and many people may conclude that ultra-violet transmitting glass, with ultra-violet treatment, has been entirely a fad.

Opinions which the SCIENTIFIC AMERICAN has just gathered from the ablest authorities, both physicists and physicians, who have done scientific research in the ultra-violet, quite clearly point out that in some instances too broad claims have been made for this glass. Other evidence

TESTING CARBON ARC

Dr. W. W. Coblentz of the Bureau of Standards conducting a test on a carbon arc lamp which is situated at his left side and is shining through the dark hole, *h*, in the asbestos screen in front facing the observer. Note screen for eyes

indicates that not all claims made are exaggerated, as the reader might unjustly infer from this statement, but that some of them can be made good wholly, while others are scarcely warranted at all. In short, there is almost certainly a place for the new glass, but the present indications are that this is not every place.

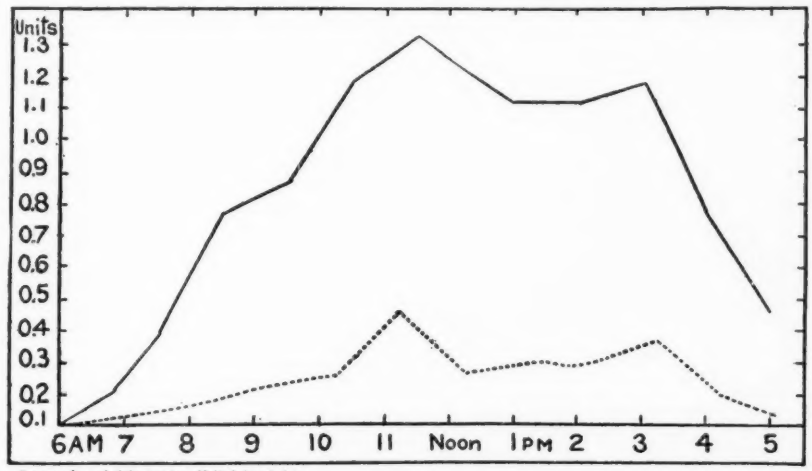
Although the medical journals and some of the technical publications having a limited circulation have kept the scientific worker himself well informed concerning progress in the work during the past year or two since ultra-violet transmitting glass became available to the public, no authoritative summary of the subject, except several written from a single writer's point of view, has yet been put in the hands of the public. It was therefore decided to place the matter, in a formal questionnaire, before a number of the best-known authorities on the subject and to publish their replies in the SCIENTIFIC AMERICAN. Unfortunately this has not proved practicable, because the replies are too long; also because virtually every aspect of the subject, still young as was emphasized above, is very largely a matter of opinion, or more precisely, of many shades of opinion, and it has proved impracticable to render a classified summary of the different opinions offered in the whole Questionnaire.

IN the exact sciences it is possible to answer a question by yes or no. In many other sciences a definite yes or no answer to the majority of questions is possible, but when dealing with ultra-violet transmitting glass there is a large variety of factors, most of which are variable, and the answers to specific queries are usually contingent on the nature of these variables. Such variables, for example, are locality, latitude, altitude of station, time of day, degree of local pollution of atmosphere or freedom from pollution, local variation in sunshine, purpose for which the glass is to be used, size of glazed areas, variety of special glass, direction the window faces, areas of skin exposed to sunlight, condition of patient, and others, each of which must be carefully weighed before statements concerning the glass can be brought under anything approaching a definite scientific law. As Dr. Charles Sheard of the Mayo Clinic puts it, "Mr. Heinz with his 57 varieties of pickles has nothing on the biologist, bio-physicist and bio-chemist as they endeavor to draw conclusions relative to the effects produced by such an agent as ultra-violet light."

Notwithstanding that the replies to the "SCIENTIFIC AMERICAN Questionnaire on Ultra-Violet Transmitting Glass" are too long to publish here, they will be made available in pamphlet form and in the exact words of the noted scientists who so willingly provided them, if the response from our readers is sufficient to justify their preparation. This procedure, if warranted, would enable those who are interested to derive their own estimates of ultra-violet transmitting glass at first hand from the best scientific authorities available at the present period.

AMONG those whose detailed replies have been received are Dr. A. F. Hess of New York University and Bellevue Medical College, who first demonstratedthe curative effect of sunlight in rickets; Dr. Henry Steenbock of the University of Wisconsin, whose researches on the biological effects of ultra-violet have won him world-wide fame among scientists, and whose discovery that foodstuffs could be given antirachitic properties by direct irradiation with ultra-violet rays forms the basis of the "million dollar" patent which he generously donated to the world under legal safeguard calculated to guarantee it against sensational unscientific exploitation; the physicist Dr. W. W. Coblentz, specialist in radiometry, Chief of the Radiometry Section of the United States Bureau of Standards, the scientific accuracy of whose official laboratory determinations of the transmission of ultra-violet rays by all kinds of glass was voluntarily commended by many of the other scientific authorities who replied to the Questionnaire; Dr. Walter H. Eddy of Columbia University, who has performed extensive research on animals and human beings behind ultra-violet transmitting glass, and who has written extensively on the subject in magazines read mainly by mothers of children; Dr. M. Luckiesh, Director of the Lighting Research Laboratory at the National Lamp Works of the General Electric Company, author of "Ultra-Violet Radiation" and co-author with Dr. Pacini, of "Light and Health;" Dr. Janet H. Clark of Johns Hopkins University, whose recently published laboratory determination that a child would receive as much ultra-violet vitalizing rays in two minutes out of doors in noon sunlight as in 20 hours when seated 16 feet from a north-facing window glazed with ultra-violet transmitting glass has had possibly more effect on the opinion of other scientists than any other pieces of recent evidence concerning this kind of glass, and, in the opinion of some, has injured its distribution more than any other factor; Dr. Leonard Hill of the National Institute for Medical Research, London, widely recognized as the ablest authority in Great Britain on ultra-violet in connection with health; Dr. Charles Sheard of the Section of Physics of the famous Mayo Clinic, noted bio-chemist and research worker; and numerous others.

Several varieties of ultra-violet transmitting glass and flexible glass substitutes are now readily available for use, some of these being obtainable in standard window-glass sizes, either transparent or translucent. As far as appearance goes it is not easy to distinguish some of the transparent varieties from common window glass. Why these special glasses transmit the desired shorter wavelengths of the ultra-violet is partly a trade secret, but the main reason is that every possible precaution is taken in the manufacture to avoid contamination with iron. It is this element, contained in common window glass, which absorbs these valuable wavelengths, preventing them from coming indoors.



Courtesy *Journal of the American Medical Association*

SUNSHINE AND SKYSHINE

Intensity of ultra-violet radiation of the sunshine and skyshine, respectively, at Boulder, Colorado, during the day of June 30, 1928; solid line, sunshine (12 observations); broken line, skyshine (12 observations). The relative intensity is measured in zinc sulfide units

What is ultra-violet light, radiation, rays, or waves, as it is variously and correctly termed? This simple question and its answer may perhaps insult the reader's intelligence, but there is nevertheless enough existing evidence that this point is not widely understood to justify a homely explanation.

Everyone is familiar with the so-called spectrum of light. A glass prism produces such a spectrum. If a sunbeam be allowed to fall on such a prism its component colors are sorted out by the glass and we see them in the familiar spectral series—red, orange, yellow, green, blue, violet. This, however, is not the whole of the spectrum of sunlight; it is only the part which our eyes are adapted to perceiving. Easily performed experiments show us that this visible spectrum of light has two invisible "annexes," one on either side. On the side adjacent to the red is the infra-red, a synonym for radiant heat. This can be had from a common electric bathroom heater. If we could see the solar heat spectrum we should find it several times as extensive as the visible spectrum.

On the side adjacent to the violet end of the visible spectrum is another "annex," equally invisible to the human eye, although some animals can see a portion of it. This is the ultra-violet.

Why our eyes perceive only a fraction of the sun's entire spectrum is possibly due to the fact that Nature, always economical, was able to devise the sense of sight without using more of it. Why a middle instead of some other portion of the spectrum was chosen is possibly because more radiation from the sun reaches the earth in that precise portion than in any other.

How are we to visualize a part of the spectrum, the ultra-violet, which we cannot see? It cannot be visualized, any more than a man blind from birth can visualize green, yellow, or any other color. It is possible, however, to form a definite mental concept of ultra-violet light by a simple analogy with visible light.

THE latter consists of vibrations or waves, very rapid and very short from crest to crest. It will help to think of tiny wavelets advancing across a basin of water. (This analogy is not exact, but the popularization of science often justifies cutting a few corners to avoid confusing some of the readers with exceptions, ifs, and ands).

If we had on our basin of water a number of waves of several different lengths, superimposed on one another and all moving in the same direction at the same time, we should have a fair analogy with ordinary sunlight. It is a mixture of waves of different lengths. In such an analogy the "red" waves

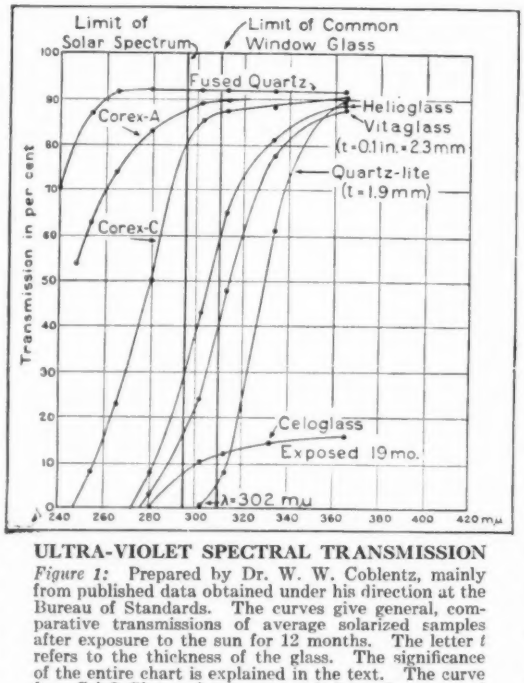
would be about twice as long from crest to crest as the "violet" waves at the other end of the visible spectrum. Between these lengths would be waves of all intermediate lengths, giving not only orange, yellow, green, and blue light, but the intermediate gradations of each color actually discoverable in a closely examined spectrum of sunlight.

Carrying our water-wave analogy into the ultra-violet radiation of sunlight, what we have here are simply waves of the same kind which are still shorter from crest to crest than any in the visible spectrum. Even ultra-violet waves are not, however, all of equal length, any more than those of the parts of the visible spectrum. They are of *all lengths* intermediate between that of the longest visible violet wave, and waves about three fifths as long as that wave. This is the solar ultra-violet spectrum. It will be important in the most elementary consideration of ultra-violet light to remember that its waves are not all of equal length, and that their variation in length has a deep significance in physiology and therapy.

IN sum, then, it is wholly accurate to think of the sunbeam that streams into an open window as being composed of an immense number of extremely minute waves of quite widely different lengths, the longest being heat (infra-red) waves, those of a medium length being visible light and the shortest being ultra-violet, all forming a graded series. All these waves are *identical in nature, differing in only one respect*—wavelength. The fact that many have been led to regard heat, light, and ultra-violet radiation, as intrinsically different is perhaps due to the fact that they happen to act differently on our different senses, and that they act in a different manner with regard to various substances—passing through certain of these substances but not through others, for example.

This much has been explained in order to offset a belief that has become rampant, especially since the market has become flooded with ultra-violet lamps—namely, that ultra-violet rays are something physically quite different from visible light, and especially that, whatever they are, they are all essentially alike, as if they were something squirted out of a hose. Thus, a variety of ultra-violet transmitting glass might have a high transmission "*in* the ultra-violet," without being appreciably better than common window glass. What we must know about any variety is its transmission in a certain *specific part* of the ultra-violet—certain bands of wavelengths. If this fact were well and widely understood it would simplify greatly the difficulty of making apparent why one variety of glass may be superior to another kind, and why certain statements which have been made are misleading.

It is not necessary to become a physicist in order to grasp the main features or landmarks of the solar ultra-violet spectrum. A careful study of Figure 1 will not only make clear these landmarks, enabling the reader who does not already understand them to follow technical articles about the subject and to understand a common spectrogram (likely to become increasingly common), but will make considerably plainer the specifications of ultra-violet transmitting glass. Incidentally it will help the reader to interpret the available literature on ultra-violet lamps. This figure or graph will therefore be discussed through several paragraphs.



ULTRA-VIOLET SPECTRAL TRANSMISSION

Figure 1: Prepared by Dr. W. W. Coblentz, mainly from published data obtained under his direction at the Bureau of Standards. The curves give general, comparative transmissions of average solarized samples after exposure to the sun for 12 months. The letter *t* refers to the thickness of the glass. The significance of the entire chart is explained in the text. The curve for Cel-O-Glass shows transmission that passed straight through the sample into the spectrometer slit, no corrections having been made for diffused rays. Such a correction would increase the transmission of this glass substitute by several percent

The term "ultra-violet transmitting glass" as applied to the new glasses was not well chosen, for all ordinary window glass transmits ultra-violet rays, and actually the majority of the wavelengths of the ultra-violet of the sunlight—specifically about five sixths of these wavelengths. In spite of this fact, it is the small remaining minority of the ultra-violet waves of sunlight, the shortest ones, which we are perhaps most anxious to get—especially in the cure or prevention by sunlight of the bone deficiency disease of infants called rickets (bow legs, knock knees, pidgeon chests, short chins, chalky teeth), for here no others will suffice. Ordinary window glass happens to exclude all of these same short wavelengths which are so highly prized. It is not transparent to them. It entirely absorbs them. On this all authorities, both physicists and physicians, are agreed. It is axiomatic.

Referring again to Figure 1, the numbers 240, 260, and so on, across the bottom of the graph, indicate in minute fractions of a millimeter the various wavelengths of the radiation; for example, 240 means 240 millimicrons, a millimicron being the millionth part of a millimeter. Incidentally, we now see that light waves are extremely short; our analogy of the basin of water was greatly overscaled.

At the extreme right of the diagram the number 420 millimicrons falls within the visible part of the spectrum, in the violet. The violet begins where the visible spectrum begins, at 390 millimicrons, and extends to the right, off the scale. At the extreme left of the diagram the number 240 millimicrons lies far within the ultra-violet—farther in fact, than the sun's radiation ever extends. Waves of this length may be obtained only from artificial sources.

Between these limits are three "landmarks," each indicated on the diagram. These should be noted carefully because they figure prominently in every discussion of solar ultra-violet ray treatment which goes beyond the most elementary stage. These landmarks are (1) the approximate short-wave limit of the solar spectrum at wavelength 295 millimicrons; (2) the point 302, that of a certain band of wavelengths having marked antirachitic properties; and (3) the limit of common window glass at wavelength 310 millimicrons—the second heavy vertical line.

SINCE waves shorter than (that is, to the left of, in the diagram) 295 millimicrons are not contained in sunlight, and since waves longer than 310 millimicrons are already transmitted by common window glass, virtually our entire attention in considering the value of ultra-violet transmitting glass, will be centered on the wavelengths between those limits, indicated by the two heavy vertical lines.

These, the shortest of the ultra-violet waves of sunlight, are vital to health, especially in the cure and prevention of rickets. Many writers, and some salesmen of ultra-violet transmitting glass and ultra-violet emitting lamps, have called them the "vital" or "vitalizing" wavelengths. As the entire solar spectrum is relatively vital,

a more scientific, less misleading description of this part of the ultra-violet spectrum would be simply "solar waves which are not transmitted by common window glass."

The *total* solar spectrum extends all the way from 295 millimicrons on the left, through 95 millimicrons range of ultra-violet wavelengths, 380 millimicrons of visible wavelengths and about 3000 millimicrons of infra-red wavelengths—a great gamut of 3500 or more millimicrons in range of wavelengths, of which all but 15 millimicrons already passes through common window glass. Therefore, the reader may ask, why worry at all about special glass? However, many experiments with human beings and animals made during recent years by many research workers, in which access to ultra-violet radiation of wavelengths not transmitted by common window glass, or its equivalent in some other form, was denied, have provided decided cause for such worry. Narrow as this special band of wavelengths is, it is one of the vital needs of the physiological organism.

HOW it happens that common window glass comes so exasperatingly near to transmitting the whole spectrum of solar radiation yet does not actually accomplish that feat, often perplexes those interested. The reason—impurities in the glass—has already been explained, and it seems almost like a case of the proverbial "cussedness" of inanimate objects. However, this bit of "cussedness" can be and is gradually being removed, for several varieties of ultra-violet transmitting glass are already available. Also, time and improved processes of manufacture are likely to see an increase in the percentage of the ultra-violet they transmit.

The logical answer to the question, why it is that common glass transmits nearly but not quite all the vital wavelengths, may, then, ultimately prove to be one of performance on the part of the glass industry—*better glass*. Thus at some future time "common" window glass may acquire a new definition. Common glass will be defined as "glass that transmits a high percentage of the radiation in *all* the wavelengths of natural sunlight." To quote Dr. W. W. Coblentz of the Bureau of Standards: "No doubt in a few years, new ultra-violet transmitting glasses will be a common article of commerce, costing little more than common window glass."

Thus far the reader has been given no reason to suspect that the band of solar wavelengths not transmitted by common window glass, but partly transmitted by certain available special glasses and flexible glass substitutes (see curves in Figure 1), is not invariable in width in all circumstances. It is a fact, however, that even this range of wavelengths, or some part of it, is frequently lacking in natural sunlight. At such times there is a corresponding loss of advantage derivable from ultra-violet transmitting glass. Also, wherever the rays are totally lacking in the sunlight they may not even be had by going out of doors, a fact which some appear to have overlooked. Atmospheric pollution; altitude of the station above sea level; altitude of the sun (angle above horizon), latitude—these are the factors which control the volume or total intensity of these rays. First; smoke, dust, and moisture filter out the sun's short waves, depending on the amounts present. And the shortest waves, because they are the least penetrative, are the first ones to go. Second; the lower the altitude of the sun, due to the hour of the day, the longer the path of the ray, even in clear atmosphere, hence the greater the loss. When compounded with atmospheric pollution this effect is enhanced. Third; the sun's altitude above the horizon, due to the changing seasons, also influences the length of the path its rays must traverse before reaching the earth. If the sun's altitude is high, as in summer, this path is shortest, but when the sun's altitude is low, as in winter, it is very greatly increased in length, the two effects, those of hour and season, being compounded at such times. Often all three effects are compounded. How this works out is shown in Figure 2. Obviously, high latitudes would add a further factor at all times, because the sun's rays would reach the earth still more obliquely; but lower latitudes would favor the ultra-violet, all other things being equal. Altitude of the station favors the ultra-violet.

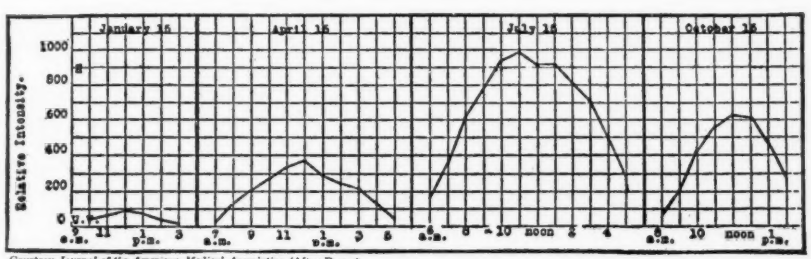
With these factors conspiring more or less to diminish the special advantage of ultra-violet transmitting glass, is it to be wondered that many research workers, physicians, and others, are now demanding glass which transmits the highest possible percentage of the short-wave radiation which reaches the earth's surface?

Chicago furnishes an interesting example of the effect of atmospheric pollution, compounded with the winter sun's low altitude. Doctors Bundeson, Lemon, Falk, and Coade, of the Department of Health of that city, measured from day to day throughout the winter of 1926-1927 the lower limit—that is, the short-wave limit—of the ultra-violet detectable in sunlight. The records begin November 28, the shortest waves of that day having a length of 303.5 millimicrons. This does not even uncover the rickets-protecting landmark at wavelength 302. This is a potent anti-rachitic wavelength, although recent research conducted at Cornell University by Dr. George H. Maughan indicates that a still lower one at 296.8 millimicrons is perhaps four times more effective.

ALL through the month of December, and until February 11th, the Chicago experimenters did not once record a wavelength shorter than 303.5 millimicrons. From that time on, the radiation was shorter than 302, and may therefore be termed available anti-rachitic radiation. By April it stood mostly at 300, and on May 16 it had reached 299, and doubtless remained mainly below that position all summer.

Winter and atmospheric pollution thus cheated Chicago out of part of its claims on the ultra-violet. The same conditions exist in a relative measure in other cities. In general, the amount of ultra-violet in the country is 50 percent more than in the city. The four physicians who conducted the experiments reported to the American Medical Association that "comparatively little ultra-violet radiation of known physiologic significance appears in the sun's spectrum in the winter months in Chicago. The ultra-violet rays are absorbed to a significant degree by smoke in the atmosphere.

On the other hand, experiments conducted on rats by Captain William D. Fleming of the Army Medical School in Washington, D. C., clearly indicate that Vitaglass protects these animals to some extent against rickets in that locality in the winter months. As Washington is clean and comparatively free from atmospheric pollution,



Courtesy *Journal of the American Medical Association* (After Dorno)

VARIATIONS IN THE ULTRA-VIOLET RADIATION OF THE SUN

Figure 2: This chart gives a general idea of how the daily and seasonal effects are compounded at different times. These effects are fully described in the accompanying text

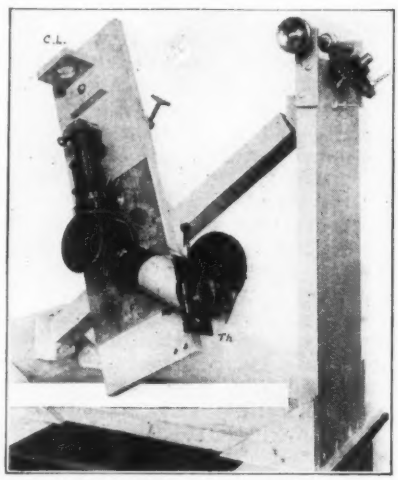
as well as farther south than Chicago, it may perhaps be taken as an example of a place where good results may reasonably be expected from ultra-violet transmitting glass when used under otherwise advantageous conditions.

In making experiments on the biologic effect of radiation filtered through glass it is difficult to reduce all the existing factors to parity. Animals such as rats and chickens are more easily managed than human beings, who cannot often be penned up for months behind ultra-violet transmitting glass while another control group of persons is similarly incarcerated behind common glass, fed a rachitic diet and allowed to develop rickets until its members cannot stand up. Most authorities agree that the observations made from experiments on animals apply to human beings, although several state in their answers to the Questionnaire that these observations would apply only if the human beings were kept naked like the animals, so that they might absorb a corresponding amount of radiation.

ANOTHER variable factor in making tests with human beings, often a large one, is the psychological element. Even if one endeavors to make one's observations scientifically and without bias this is difficult to avoid. To test the psychological factor in one case, the writer, in the interests of science, played a reprehensible caper on a member of his own family. Offering to bring home a window of an unnamed ultra-violet transmitting glass and install it in a south facing window behind which this member habitually sits, a pane of common window glass was secretly purchased instead. While the putty was being removed in order to replace the old pane the subject of the experiment unexpectedly left the premises. This "assist" permitting a further piece of skullduggery, the old pane behind which she had sat so many years was not even removed, but fresh putty was substituted for the old, and the glass was smeared with oily hands in order to complete the verisimilitude.

The subject in question had previously stated that she was quite well. Apparently she permitted the installation to be made on general principles, and without knowing what specific benefits might be expected to accrue from the glass. Although scrupulous pains were subsequently taken not to ask the subject of this depraved experiment any leading questions, or to coach her on what exact effects might be expected from the glass, she has repeatedly volunteered the remark that "this glass is *very* much better than the old glass. It burns my scalp right through my hair." Numerous remarks of similar nature, to which other members of the family have added emphatic concurrence, have been heard. For example: "This glass is far warmer than the old glass—that is *certain*." (Ultra-violet rays are not heat rays.) The writer's next great problem will be to prevent a copy of this article from falling into the hands of his family.

This experiment in human psychology speaks for itself, regarding the difficulty of obtaining accurate scientific observations on ultra-violet transmitting glass when the subject of the experiment is permitted to know that a test is being made upon him or her. The psychological factor is difficult to eliminate. Tests of ultra-violet transmitting glass made on school children should therefore be made without the least inkling on the part of children or teacher. Testimonials based on such tests as this have, however, been used in some cases as an argument favoring the purchase of ultra-violet transmitting glass.



MEASURING ULTRA-VIOLET

Some years ago this instrument, the spectropyrheliometer, was devised by Dr. W. W. Coblentz for measuring the ultra-violet rays in sunlight. It consists of a fixed arm spectrograph, having lenses and a prism of quartz, mounted upon a polar axis to follow the motion of the sun. An image of the sun is focused upon the spectroscope slit by means of a cylindric quartz lens, "C. L." shown in the upper left-hand corner. The intensity of the ultar-violet spectrum is measured by means of a thermopile, "Th," shown to the lower right. This device is being used to study the amount of ultra-violet vitalizing rays in the sunlight

Perhaps the most frequent inquiry is whether the glasses are beneficial enough to justify their installation at present prices in windows which do not directly face the south. Drs. Tisdall and Brown of Toronto ascertained by experiment, and stated in the *American Journal of Diseases of Children*, that "the anti-rachitic effect of skyshine (reflected rays from the sky and clouds) is approximately from one half to two thirds as great as that produced by what is ordinarily termed sunshine (rays from the sun plus the reflected rays from the sky)." Asked whether they considered that the installation of ultra-violet transmitting glass was justifiable for north, east, and west windows, those who answered the Questionnaire gave various answers. Examples of these are: Dr. Leonard Hill (London)—"The U-V comes much more from skyshine of *whole* sky than from direct sun. But the glass is not of value in ordinary windows." Dr. Charles Sheard (Mayo Clinic)—"In general, would recommend it for south windows only." Dr. Janet Clark (Johns Hopkins University)—"I am sure it is no good except in south windows." Dr. Alfred F. Hess (New York University)—"Depends upon location, exposure of room, area of exposure of skin, and so on." Professor Harry Steenbock (University of Wisconsin)—"I do not consider the ultra-violet transmitting glasses of sufficient value to warrant their installation in other windows than those of southern exposure. In fact, I do not consider that their installation in the latter is justifiable except for special purposes." Dr. Lawreson Brown (Trudeau Sanitarium)—"I question very much the advisability of putting in this glass in the northern part of this country. Exposure out of doors for a few moments is so much better for children than exposure behind the special forms of glass that there seems to be no reason for them. In nurseries and hospitals where you can have a solarium composed of such glass, I think it might be useful. I certainly have seen children tan behind it."

SO far, the noes have it. Now come some of the ayes: Dr. David C. Hall (University of Washington)—"I believe the south and the east windows are the best, but the west helps greatly and the north less. I also believe there is considerable value to be obtained even in the absence of direct sunlight." Dr. C. E. K. Vidal (Montana State Tuberculosis Hospital)—"Positively yes." Dr. Norman E. Titus (New York)—"Yes." Dr. F. H. Slayton (American College of Surgeons)—"Yes." Professor Donald C. Stockberger (Massachusetts Institute of Technology)—"Yes. Probably a little ultra-violet entering each of a number of windows would add up to an intensity of some value." Dr. E. V. McCollum (Johns Hopkins University)—"Yes." Mr. F. E. Lamplough (England—inventor of Vitaglass)—"East and west windows will at times receive a considerable amount of sunlight. In the case of north windows it is desirable that these should be of good size and the user should be fairly close to them in order to obtain considerable advantage."

Other answers favorable to the glass are those of Dr. Earl H. Mayal (Brook-

lyn)—"Yes, I believe experiments have proved this." Mr. T. B. Kidner (consultant on institutional planning, New York)—"Yes, undoubtedly." Dr. Edison Pettit (Mount Wilson Observatory)—"Yes. In all cases of school, office, shops, and so on, where the worker, by the nature of things, cannot stand in sunlight anyway, it is the sky radiation from which he will get his ultra-violet light."

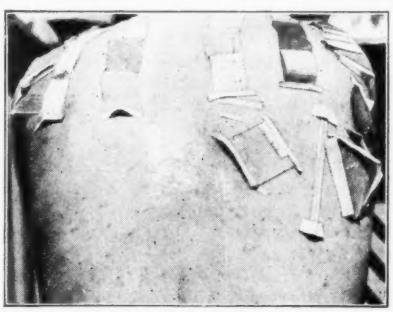
Less positive and in some instances more detailed answers come from Dr. H. P. Gage (Corning Glass Works, makers of Corex)—"East and west windows often receive considerable sunshine. The value of north skylight received through a somewhat limited north opening is as yet uncertain." Dr. Frederick F. Tisdall (University of Toronto)—"Our experiments with skyshine showed that exposure of rachitic rats to the sky's rays coming through an ordinary sized window glazed with one of these special glasses produced very little effect. This can be figured out mathematically. We showed that our source of ultra-violet rays is approximately 50 percent from direct rays of the sun and 50 percent from the sky.

"IF we install a special window on the north side of the room the ultra-violet rays available are at once reduced the 50 percent which comes from the direct rays of the sun. The other remaining 50 percent, that is the rays reflected from the whole sky, are further reduced to that percentage of the sky which we can see through an ordinary sized window—which of necessity is not more than 10 percent. Therefore, we have available as our outside source of ultra-violet rays one tenth of 50 percent, which equals 5 percent. This 5 percent is further reduced by passage through the glass by about 50 to 75 percent; in other words a patient or an individual sitting in a room four or five feet from an ordinary sized window on the north side glazed with special glass receives only from 1 to 3 percent of the ultra-violet rays that he would receive if he were outside."

Dr. Edward B. Vedder (Army Medical School)—"Yes, in cases where user can get no direct sunlight. It is obvious that this applies to very few individuals who are permanently bedridden." Dr. Bernard L. Wyatt (Desert Sanatorium, Arizona)—"That would depend on whether the user was sick or well, his economic circumstances, the latitude in which he lived, dimensions and arrangement of room, and the atmospheric transparency. Certainly 'no' for north windows." Dr. M. Luckiesh (Director, Lighting Research Laboratory, National Lamp Works, General Electric Co.)—"With the scanty knowledge available at present I would not recommend that a special glass for transmitting ultra-violet radiation be used excepting where direct sunlight is available." Dr. Brian O'Brien (Buffalo Tuberculosis Association)—"I would seriously question the installation of special glass transparent to ultra-violet light in north and other windows not receiving direct sunlight. In certain isolated cases it might be worth doing, but considering all published data it does not appear economically sound."

If any deduction might be made from these conflicting opinions and from others not quoted here, it is that the installation of the glass is at least more likely to prove justifiable in other positions than in direct south light, if it is spread over the sides and top of a solarium; rather than when the light must be received through an ordinary window which permits radiation to enter from less than one side of a room.

Dr. Walter H. Eddy (Columbia University) furnishes a peculiarly practical opinion—"I have objected to the installation of glasses in school rooms, as in the case of Bronxville, as a waste of money. Clothed children sitting away from the windows would get little ultra-violet, regardless of the windows used. I believe the Vitaglass panes have a valuable use in cases where persons can undergo exposure on the nude skin. In homes they would permit the baby to lie in his crib, nude, in the direct path of the rays, and this would save much perambulation, especially when perambulated babies are too often swathed to the nose with ray-absorbing clothing." ("The fear of injuring infants' eyes," says Dr. Charles H. Smith of the Children's Hospital, New York, "is responsible for most rickets and tetany.")



A SIMPLE TEST

Anyone can make this simple test of the ultra-violet transmitting properties of various materials. Pieces of window glass, quartz, ultra-violet transmitting glass and glass substitutes, fabrics, and so on, are attached to the skin which is exposed to the midday sun. The covered areas will be affected (*roughly*, not accurately) in proportion to percentage of short-wave radiation transmitted, observation to be delayed 24 hours. The vertical streak over the spine was a substance to protect bathers. In this particular test, it proved to be effective

It is interesting to note that those by whom the Questionnaire was answered may be divided roughly into two categories—those who have performed much original research upon ultra-violet transmitting glass and its effects, and others. It may be more than a coincidence that the great majority of the unfavorable responses proceeded from the former category.

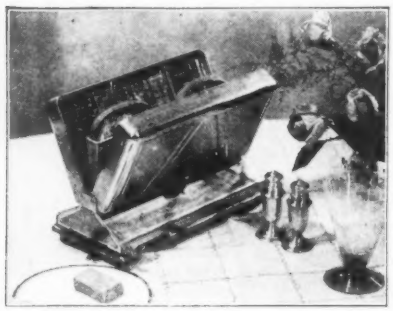
OTHER interesting considerations having to do with the ultra-violet might be answered by quotations from replies to various questions on the Questionnaire. One of these bears on the deterioration of ultra-violet transmitting glass. Apparently the suspicion has become widespread that this glass soon loses all its power to transmit the short wavelengths it is designed to transmit. The foundation of this suspicion is doubtless the fact that the potent ultra-violet rays themselves react chemically on impurities in the glass, mainly iron compounds, and that the products created by this photochemical reaction absorb and shut out some of the very same kind of radiation which brings about the change. What actually does take place is not total deterioration—as has been widely whispered—but only *partial* deterioration. As stated by Dr. W. W. Coblentz (Bureau of Standards)—"Solarization tests extending over a year of exposure to sunlight in Rhode Island, Texas, Arizona and Washington, D. C.—also accelerated deterioration tests under the carbon and the mercury arc (with and without filters)—show that all the special window glasses now marketed for transmitting ultra-violet solar radiation, decrease in transmission to a fairly constant value, which appears to be permanent." Dr. Charles Sheard (Mayo Clinic) states: "Such glasses lose some of their transmissive properties for ultra-violet but in the course of a few months become stabilized to all intents and purposes." The curves in Figure 1, it will be noted, are for glass *after* exposure to the sun for 12 months.

As emphasized early in this article, what we have available at present is not a set of definite, conclusive, finished scientific laws concerning ultra-violet transmitting glass and its uses, but mainly a large body of opinions. In these circumstances some portions of the public will incline to follow the rather negative opinions, while others will doubtless lean toward the affirmative. Dr. N. K. Chaney (National Carbon Co. Research Laboratories) perhaps best characterizes the present situation when he replies that "the continued growth in the use of one of these glasses in London to date merely signifies the awakening public consciousness to a vital need, and thus the willingness to experiment." The users of ultra-violet transmitting glass should realize that in a large measure they are experimenting. The subject is too complicated and too uncertain as yet to be regarded in any other light.

Household Inventions

ELECTRIC "WIFE SAVER"

Arduous beating is eliminated with this handsome kitchen accessory. In addition to beating eggs, mixing batter for cakes, waffles, or omelets, the electric mixer is useful for scouring dirty utensils. It is claimed that the device extracts the juice from half a dozen oranges per minute.—*Speed-Way, 1834 S. 52nd Avenue, Chicago, Ill.*

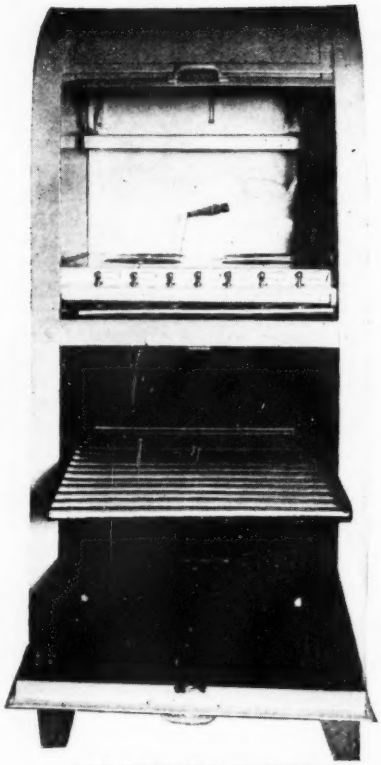


STOOL-LADDER

Combining two important uses in one, this neat little stool can be opened to provide a rigid step-ladder. Rubber treads cover the steps, and the stool is just the proper height for use near the sink or beside the table in the kitchen.—*Dillingham Manufacturing Company Sheboygan, Wisconsin*

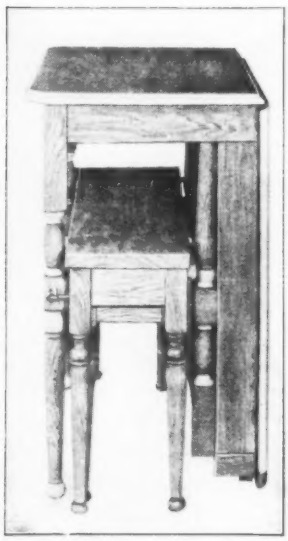
TANDEM TOASTER

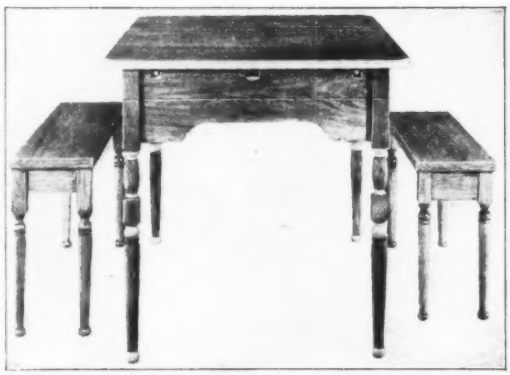
This product of the Edison laboratories toasts two slices of bread at once, and opens automatically when the toast is ready to be removed. —*Thomas A. Edison, Inc., West Orange, New Jersey*



GAS COOKING CABINET

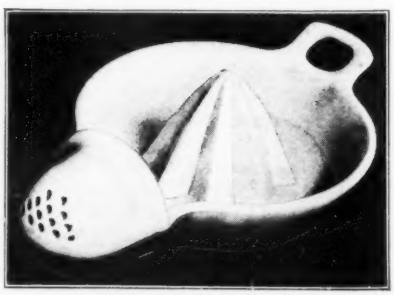
Something new in kitchen stoves is offered by the manufacturer of this gas "cooking cabinet." It is built of pressed steel, is insulated with asbestos and air, and has an oven equipped with an adjustable grid that slides in and out on ball bearings or moves up and down with a little crank. It is finished in white or in colors, and no pipes are visible.—*Pressed Steel Stove Company, 250 W. 57th Street, New York*





APARTMENT SPACE SAVER

Between meals this table serves as a flower stand or a reading table, but at meal time it becomes a regular dining room table seating six people with comfort. The benches are brought from beneath, and the extension put in place.—*Miller Frank Table Company, 228 N. La Salle St., Chicago, Ill.*

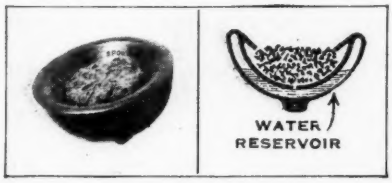


FRUIT JUICE STRAINER

The old fashioned fruit juice extractor has been improved immeasureably by adding a strainer of the proper size to fit into an ordinary glass. The juice extracted from oranges or other fruit can be poured directly into the glass, without the seeds or other waste. The device is made of hard white china.—*Corns China Company, Wellsville, Ohio*

Accessories for the Golf Player

TO those of us who, by choice or otherwise, spend the winter in the cooler climates where winter golf is the exception rather than the rule, the slowly passing days of late winter bring with them wistful visions of rolling fairways and smooth velvety greens. Then out come the clubs for cleaning and polishing and the time is at hand to take stock of the accessories. What have the past few months contributed to the art of golf? you ask yourself. And at least part of the answer is presented on this page where we show a few of the "gadgets" that are now available for the golf enthusiast. May they help you to improve your game this season.



BALL CLEANER

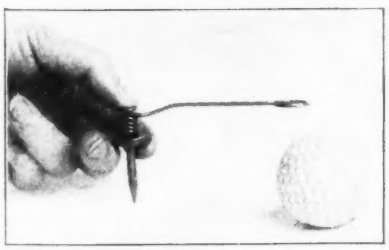
Rub the ball against the sponge in this cleaner and water from the reservoir cleans it. Can be carried safely in bag or pocket.—*St. Helens Cable and Rubber Co. Ltd., Slough, England.*

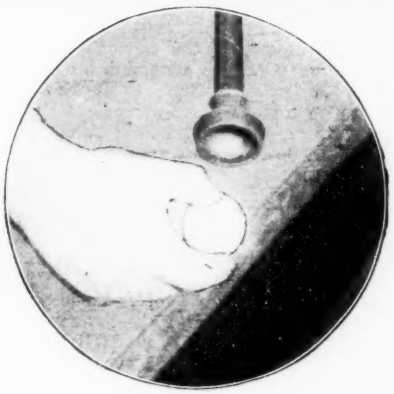
ARM SUPPORT

A sling on the carrying strap provides an arm rest for the caddie or for the player. This support is more comfortable than resting arm on clubs. *Atlantic Products Corp., Trenton, N. J.*

TEES, TEES, TEES

We illustrate three new types of tees. One at left, made by *The Angle-Tee Co., 207 Meriam Bldg., Cleveland, Ohio,* is forced into the ground at an angle and is said to offer little resistance to follow-through. Left below, made by the *Carter Golf Tee Mfg. Co., Anderson, Ind.* In this one, an arm swings around a pivot. The ball rests on a loop at the end of the arm. The third one, put out by *Perfect Golf Tee Co., New London, Wis.,* is made of rubber and comes in two styles, one to be pegged to the ground and the other equipped with a weighted string to prevent losing it.





BALL RETRIEVER

With this soft rubber cup fitted on the end of the putter shaft, balls can be lifted from the cup without stooping. When pressed over the ball, it holds it firmly. Especially useful for women.—*Abercrombie and Fitch Co., Madison Ave. and 45th St., N. Y. C.*

UMBRELLA FOR GOLF PLAYERS

Even on golf courses it rains and one can get wet before reaching shelter. Therefore, this umbrella designed especially for golfers should prove of use on many occasions. It is said to be extremely flexible and have a wide spread with a short handle. Its shallow depth lessens wind resistance. May be carried conveniently in the golf bag with the clubs. Also handy as a sunshade when the sun is strong.—*The Golf Umbrella Co., 115 Batavia St., Toledo, Ohio*

The Scientific American Digest

A Review of the Newest Developments in Science, Industry, and Engineering

Filling Station for Pocket Lighters

THE pocket lighter, that little gadget which replaces matches and supplies a light for the cigar by a simple flip of the thumb—sometimes—has become so popular in this country that many varieties of cigar-stand filling stations have been devised. A very attractive one recently announced by the Van Lansing Company of Appleton, Wisconsin, is modeled on the lines of its big brother of the automobile filling station. The lighter "gas" customer places his opened lighter under a nozzle, drops a coin in a slot, and receives one full charge of "gas." The operation is entirely automatic.

Houston's Arc-Welded Hangars

THE city of Houston, Texas, has recently erected three large hangars at its airport for the convenience of its flying guests. The hangars are of the all-metal type, corrugated iron sheeting being used to cover the arc-welded steel superstructure, rendering the hangars absolutely fireproof.

The greater rigidity and strength of this type of construction coupled with its low cost were the deciding factors.

Although these hangars were the first to be built employing the new method of construction, ample proof of the greater rigidity and strength of arc-welded steel fabrication was offered the owners, in the large commercial and industrial buildings which have been erected in various parts of the country, the steel framework of which has been entirely arc welded.

Each of the three hangars is 75 feet wide, 125 feet long, and approximately 50 feet high. The arches are made up from channel sections cut to form the arch when butted end-to-end and welded together. The entire fabrication of the arches was completed on the ground, an arch being raised into position and held in place by the welding of the channel purlins to the arches. The columns at the closed end are also channel sections. The framework of the monitors are composed of angles and channels. The steel sash in the sides and end wall were arc welded in place; in fact there are no bolts or rivets in the framework of the three hangars.

All the fabricating work on the three hangars was done in the field, all connections being made by the electric arc-welding process. Two portable gas engine driven Lincoln "Stable-Arc" welders were used to supply the welding current.

The simplicity of the novel design due to the elimination of all trusses and other forms of roof bracing is an economic factor which should favor arc-welded steel construction for future hangars. Another advantage of this design, due to its clear ceiling, is its practicability for hangars for blimps and similar lighter-than-air craft.

A coin in the slot delivers just enough "gas" to the pocket lighter

New German Cruisers are "Surprise Ships"

A NEW angle to the international cruiser question has been suddenly introduced by the disclosure of details concerning a new type of German fighting ship now building, which have just become known here. The *Ersatz Preussen*, first of a group of four to be built, represents enormously more hitting power than has ever been crowded into a 10,000 ton ship by the naval architects of any other nation. It is not unlikely that a complete revision of the specifications of the 10,000 ton "treaty cruiser" type will have to be made in answer to this latest stroke of the German Admiralty.

The *Ersatz Preussen* will carry as her main battery six 11-inch guns in two three-gun turrets, supplemented by eight 5.9-inch guns to repel torpedo attacks and four 3.4-inch anti-aircraft guns. She also carries six 19.7-inch torpedo tubes on two triple mounts.

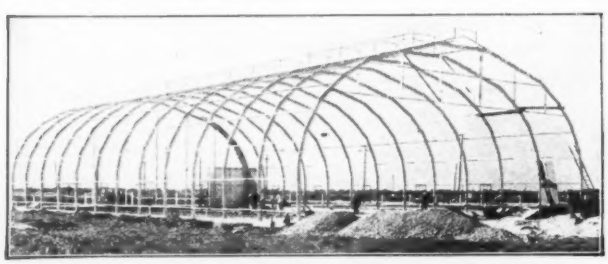
The appearance of a ship carrying guns as heavy as 11-inch, in a class where the conventional armament has been 8-inch or less, is a peculiar result of treaty restrictions. By the terms of the Versailles Treaty, Germany was forbidden to build any battleships or battle cruisers, and the size of such warships as she might construct was limited to 10,000 tons—less than a third of the displacement of modern capital ships. But nothing was said about the caliber of the guns such ships might mount. Their small displacement would, of course, preclude an armament of 14- or 16-inch pieces, such as post-war superdreadnaughts carry.

Then, at the Washington Conference, the signatory powers agreed not to build any cruisers of more than 10,000 tons. They limited themselves also to guns of 8-inch caliber. These restrictions will remain in force until 1931.

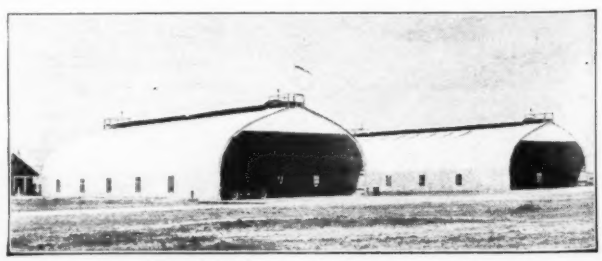
The typical post-conference cruiser, as built by Britain, Japan, and France, mounts eight eight-inch guns, although tentative plans for the American ships provided for in the 15-cruiser bill call for nine. By sacrificing armor, fuel, or machinery, enough weight might be gained to raise the battery to 10 eight-inch guns. But that would be about the limit for a 10,000 ton cruiser.

The new German ship will be able to throw from her six 11-inch guns a broadside totaling nearly 4000 pounds, for each 11-inch shell weighs 662 pounds. Eight eight-inch guns, with shells weighing 260 pounds apiece, could answer this with a broadside of not much over 2000 pounds, and a 10-gun cruiser would have only a 2600-pound broadside.

Thus, broadside for broadside, the German ships would have the post-conference cruisers out-gunned nearly two



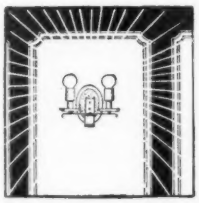
The completed arc-welded steel framework of one of the new hangars at Houston, Texas, ready for sheeting



Two of the completed hangars, each of which is 75 feet wide and 125 feet long. Note the wide entrances

Down like lead went display room costs because of this *grainless* wood

Here is a manufacturer whose sales shot up and whose costs went down when he paneled his showroom with Masonite Presdwood. Scores of others have used this sturdy material to solve a shipping problem, improve a product or cut production costs. You, too, may find, in some phase of your business, an ideal use for Presdwood. A generous free sample will be sent on request.



FOR LIGHTING FIXTURE DISPLAY PANELS

The problem of properly displaying their lighting fixtures was a "thorn in the flesh" with Victor S. Pearlman and Company of Chicago, until their architect, Bert C. Hubbard, recommended a showroom paneled in Masonite Presdwood.

Previously, fixtures were screwed to ordinary plastered walls. Changed displays left unsightly marks on the plaster. Screw holes had to be patched. And frequent redecorating was necessary.

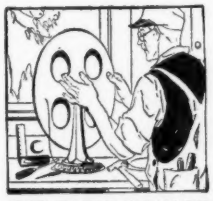
Now all the walls are paneled in Presdwood.

A different style of fixture is displayed in each section of the wall. The soft brown tone of the grainless wood panels harmonizes with the walnut finish of the rest of the room and sets off each fixture display to best sales advantage.

Presdwood saves decorating cost because it requires neither a rubbed or varnished finish. Although only one-eighth inch thick, this dense, sturdy material holds fixtures weighing up to forty-five pounds, even when ordinary wood screws are used. Old screw holes in Presdwood are easily filled. And when any section shows too many holes it can be removed and a new panel sawed out and put in its place at trivial expense.

Better products—Lower costs

But the uses of Presdwood are not confined to display room walls nor to any one industry, for in a multitude of manufactured products it is making things better while it makes them for less.



FOR RADIO SPEAKER TENSION BOARDS

It is used in radio cabinets, tension boards for loudspeakers, show cases, table tops, portable billiard tables, book cases, kitchen cabinets, china closets and for toys and playhouses.

It makes sturdy shipping boxes with ample strength to protect delicate articles. And it makes smooth boxes with no splintering surfaces to damage sheer silks or the finest fabrics. Because of its resistance to moisture, it is used for dairy product containers, for outdoor signs that are exposed to the weather and for side panels of motor truck bodies that must stand up under the hardest usage.

Liked by production men

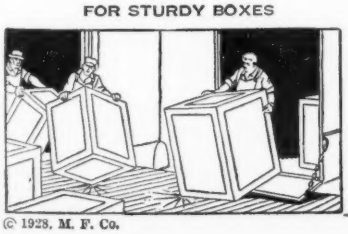
Presdwood is easily worked, for it contains no foreign binding material to dull good tools. It is made in four foot by twelve foot boards, either one-eighth inch or three-sixteenths inch thick. It can be punched, die-cut, milled or sawed. And because it lends itself so readily to quantity production methods, it is becoming as popular with the factory production manager as with the sales executive who specifies it for display rooms.

Give Presdwood a trial. It may solve a display or production problem for you as it has for others. A large free sample is yours for the asking.

MASONITE CORPORATION
Sales Offices: Dept. 736, 111 W. Washington St.
Chicago, Illinois

Mills: Laurel, Mississippi

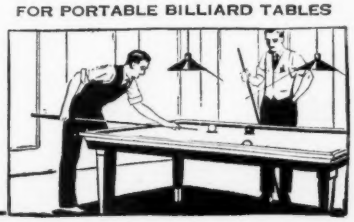
FOR STURDY BOXES



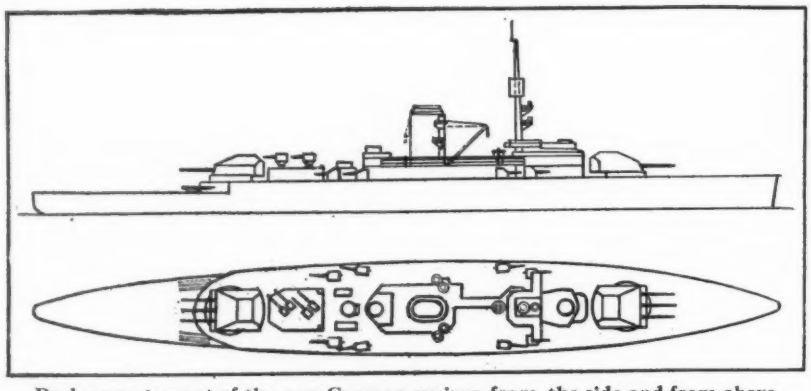
Masonite PRESDWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION

FOR PORTABLE BILLIARD TABLES



© 1928, M. F. Co.



Deck arrangement of the new German cruiser, from the side and from above. The 11-inch guns are in the forward and aft turrets; other guns as shown

to one. The eight-inch gun can be fired faster, thus cutting down the discrepancy somewhat; but against this must be balanced the long range of the German 11-inch gun, which is reported to have an extreme reach of 30,000 yards. The chances are that in an engagement between one ship of this new type and two post-conference cruisers, the German could hammer her opponents to pieces while they were endeavoring to close in to a range where their own eight-inch guns would be effective.

The engineering features of the *Ersatz Preussen* are said to be as remarkable as the power of her battery. Weight was saved wherever possible by the use of light-metal alloys and the highest grade steels. This effected an economy of some 550 tons, a saving of 5 percent on the capital of 10,000 tons displacement. The new ship will be driven by internal combustion engines of a new and radical type, developing a unit of horsepower for every 17½ pounds in weight, as against one horsepower for every 55 pounds in the best type of internal combustion marine engines now commonly known. Details of the new type of engine have not yet been made public.

The speed of the *Ersatz Preussen* is to be 26 knots, and the German Admiralty states that she will carry enough fuel to make a continuous voyage of 10,000 miles at 20 knots. The most efficiently engined of present cruisers can travel that far, but only at the much lower speed of 13 knots. What the German ship could do at that speed is not known, but it has been estimated that she might cruise 18,000 miles or almost three-fourths of the circumference of the earth.

The naming of the new type of warship is presenting a puzzle. She is much too small to be called a battleship and too heavily gunned to be called a cruiser. The German Admiralty has called her simply an "armored ship," and let it go at that.—*Science Service.*

Drainage Pump Operated by Outboard Motor

A NEW type drainage pump which is powered with outboard motor and which is unique in that it is self-priming and will shut itself off whenever there is no water to be pumped, is now being manufactured by the Johnson Motor Company, builders of several types of outboard motors for boats.

This pump consists of a long pump shaft with a light twin cylinder outboard motor mounted on the top. The motor powers the impeller which is located at the bottom of the shaft. As the pump shaft sinks to the bottom of the water and the impeller is always submerged, no air can be sucked while there is still water to be pumped; thus delays in priming are eliminated. In addition, starting difficulties are also eliminated as the water begins to flow immediately after the motor is started. One of the most troublesome of pumping problems is thus eliminated.

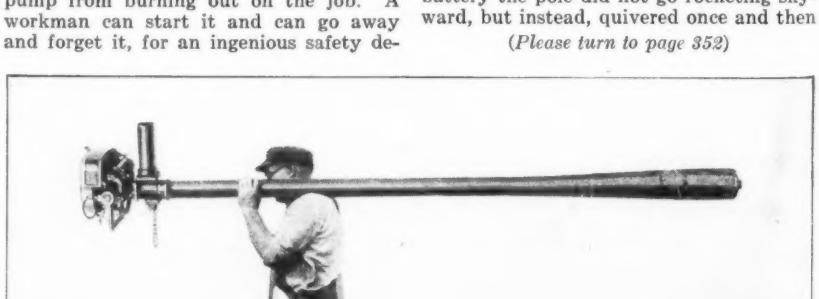
Draining a manhole with the pump powered with an outboard motor

The automatic shut-off prevents the pump from burning out on the job. A workman can start it and can go away and forget it, for an ingenious safety device short circuits the magneto of the motor when water is not passing through the pump.

Contractors of all kinds, public utility companies and others have found uses for this pump on a wide variety of jobs. Some of these include pumping water from excavations, concrete forms, manholes, and barges. It is also found highly useful in dredging work of all kinds.

It will pump 195 gallons of water per minute and 1000 gallons for the approximate cost of one cent. It is claimed that it can do in five minutes what would require an hour and half for one man with a hand-operated pump, and with a half gallon of gasoline what another unit may do on a quarter of a ton of coal.

Where a truck might have been formerly used in transporting pump equipment from one job to another, this pump, weighing only 85 pounds, can be carried over the shoulder of a laborer. If long distances are involved it can be placed on the side of an ordinary automobile.



The outboard-motor-powered pump weighs only 85 pounds

Setting Poles with Dynamite

WHAT would you think if you happened along in time to see a line construction gang go through the silly act of standing a 50-foot pole on end on the surface of the ground and then saw the men stand back with rope guys and wait as if they expected someone to come along with a 100-pound hammer and drive the pole to its required depth? But how your curiosity would turn to awe when you felt a slight earth rumble and witnessed the pole slide gently into the ground to a depth of 10 or 12 feet.

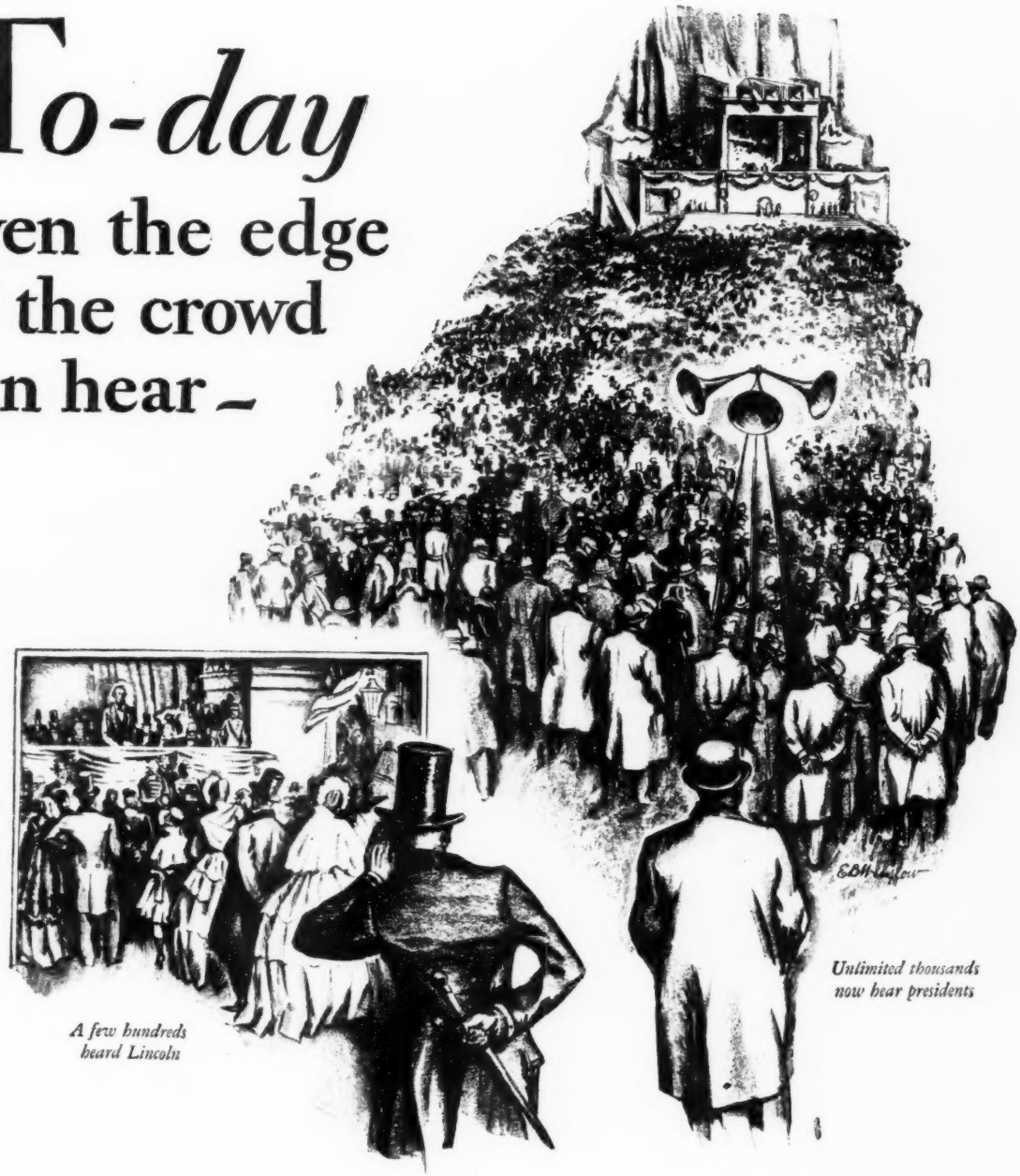
This is an everyday occurrence in Florida. The method of setting power and telephone line poles with dynamite has been developed into an art, according to F. F. Johnson in the *O. B. Bulletin.*

The story goes that several years ago a laborer in a gang erecting poles in the soft soil of Florida, professed that he had been a "powder monkey" by trade and asked the foreman to give him a chance to blow a couple of holes in the soft ground and then see if they could not jam a pole into the hole before it caved. This method worked out fairly well except when the hole caved too soon or the pole when once down came popping out as though it had hit a powerful spring.

The foreman began to wonder just how high in the air a pole would go if stood on end over the powder hole before a blast. He let his curiosity get the better of his judgment and when the "joke shot" responded to the electrical current from the battery the pole did not go rocketing skyward, but instead, quivered once and then

(*Please turn to page 352*)

To-day
even the edge of the crowd can hear –



A few hundreds heard Lincoln

Unlimited thousands now hear presidents

AT present-day inaugurations of Presidents of the United States, everybody in the vast crowd assembled at Washington is able to hear every word of the ceremony. A Western Electric Public Address System, with its loud-speaking horns above the speaker's stand and at strategic points in the crowd, makes this possible.

This apparatus amplifies sound and distributes it to all parts of a city park or square or an indoor auditorium. In convention halls of hotels, it brings the speaker's voice loud and clear to people in the rear seats.

The Public Address System has a growing use in hotels, in amusement parks, in hospitals, where music or other entertainment can thereby be distributed from a single source to any number of places or rooms. The equipment is adapted to a wide range of requirements.. A product of the telephone art, the Public Address System is electrically and mechanically dependable. It is made by Western Electric and sold by Graybar Electric—two names that mean quality and service in things electrical.

Western Electric

PUBLIC ADDRESS SYSTEMS

Distributed by **GRAYBAR** *Electric Company*

Capt. George Fried,

"Reach for a Lucky instead of a sweet."

"AN S. O. S. from the 'Florida'! We change our course. We on the 'America' strain to arrive in time to rescue the men on their sinking ship, 350 miles away. Through the icy, freezing storm and high seas we plunge on—all speed ahead! Then the night-time rescue, the search lights, the whirling waves, the manoeuvering to get near the 'Florida.' Finally, the 'Florida's' crew coming off one at a time, pulling themselves through the water on the line our men had thrown them. These 32 men, dazed, many half clothed, needed reviving after their long exposure. Hot coffee, food and Lucky Strikes—these gave new life to many of them and we on board the 'America,' crew and passengers alike, found after the strain and struggle that there was nothing quite so comforting and relaxing as the inviting, toasted flavor of Lucky Strikes. Playing this game with 'Davy' is ever fascinating, ever thrilling. And we who follow the sea must be ever ready for adventure. Ours is an active life, demanding nerve control and physical fitness. In my health program I have found that Luckies are most important not only because they provide a respite for frazzled nerves and an exhausted body but because whenever I crave anything which is over-fattening, I say to myself, 'Reach for a Lucky instead of a sweet.' In the toasted flavor of Luckies, I get complete satisfaction. And I find that toasting, by removing the irritants, protects my throat."

Jas. Fried

George Fried
Commander of "S. S. *America*"

"REACH FOR A LUCKY INSTEAD OF A SWEET."

© 1929. The American Tobacco Co., Manufacturers

"It's toasted"

No Throat Irritation - No Cough.

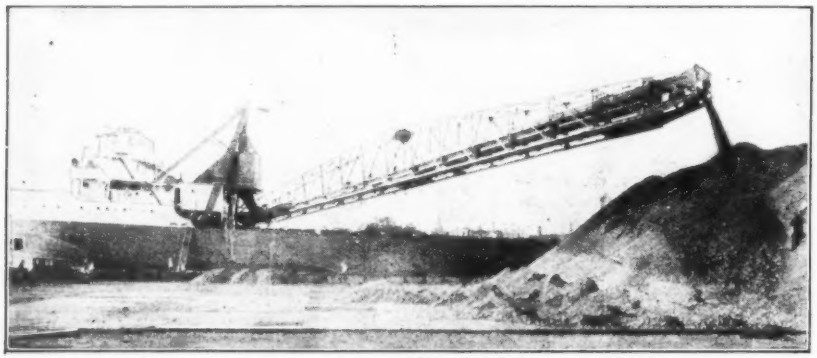
heroic rescuer, says:

Note: Authorities attribute the enormous increase in Cigarette smoking to the improvement in the process of Cigarette manufacture by the application of heat. It is true that during the year 1928, Lucky Strike Cigarettes showed a greater increase than all other Cigarettes combined. This confirms in no uncertain terms the public's confidence in the superiority of Lucky Strike.

settled into the ground without the flying of dirt as from the previous blasts.

With this start, a study of the use of explosives in pole erection has led up to its present state of efficiency in soil conditions comparable to those in Florida.

The Florida Power and Light Company uses the method for swamp land. At the pole location, a one and one half inch pipe is worked into the ground by the use of a one half inch rod for a plunger inside the pipe. With this agitation at the point of piercing, the pipe is easily pushed downward by the weight of two men applied on Stilson wrenches at opposite sides of the pipe. The pipe is forced to a depth representing the depth desired to set the pole, the plunger rod is removed, and several sticks of dynamite are dropped into the pipe and pushed to the bottom. The inertia of the pole at the instant of explosion tends to prevent an upward movement and what little ground disturbance takes place is seen around the pole. As the pole slides into place, gases from the shot leak out between the soil and the circumference of the pole. This pressure would indicate that the confined gases tend to retain the pocket walls awaiting the pole.—*Power.*



Unloading a cargo from the lake steamer that carries its own unloading equipment. A conveyor belt carries coal, gravel, et cetera, far out on the dock

Lake Steamer Carries Own Unloading Equipment

SPEED in the handling of bulky materials is at present the one big cry of industry. Get material on cars or in the hold of a vessel in a hurry; get it to the consumer in a hurry; and get it off the cars or out of the hold of the ship in a hurry. To answer this urgent trend a Great Lakes vessel has been equipped with special unloading machinery which is ready for service the minute the dock is reached and, because of this, no time is lost in getting the cargo unloaded and having the boat under way again for another trip.

The unloading machinery of this ship, the *Charles C. West*, was designed to operate with as little attention as possible. Steel compartments in the hold carry 8000 tons of bulk cargo. These bunkers are divided into two series on each side of the ship, and each series has 35 individual hoppers equipped with a gate operated by a power device. Under each series of bunkers runs a belt conveyor which carries the material to the forward end of the ship where it is fed onto another belt conveyor and then delivered to a bucket elevator.

This bucket elevator raises the material to a point above the decks where it is dumped into a hopper for feeding the great boom conveyor which is swung out over the side of the ship. The hopper gates of the cargo bunkers may be opened or closed by an operator, who uses a series of control levers so that the cargo may be kept in proper trim in shallow waters. The unloading capacity of this ship is 1800 tons of stone per hour.

The *Charles C. West* is 470 feet long, has a beam of 60 feet, and is 31 feet deep. It is designed to carry a full load with a much shallower draft than is usually the case, and is equipped with twin screws to give greater maneuverability in restricted channels and in ports where tugs are not available.

One of the biggest advantages of such a self-discharging ship is that she can unload at any dock not equipped with discharging machinery.

Joining Glass to Metal by Soldering

THE sealing of joints between glass and a metal, such as brass, by soldering, is a convenient way of overcoming the difficulty usually experienced in hermetically sealing such joints. The method consists of plating the glass with a metal, such as silver, after which soldering may be accomplished in much the usual manner.

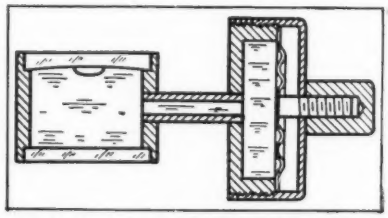
One application of this sealing process is shown in the accompanying illustration, which is a diagram of a spherical or universal level vial with bubble size control such as is used in certain aircraft instruments where the size of the bubble will be affected by changes in altitude.

As the bubble is composed of a globule of vapor which behaves in the characteristic manner when its surrounding pressure is changed, it is necessary to provide such a level vial with an adjustable expansion chamber so that, as the bubble expands when the ship rises, more liquid may be forced into the vial by depressing the reservoir diaphragm.

The liquid in the vial must be of low viscosity at any temperature likely to be encountered, and a solution of alcohol and water is frequently used. The thinness of this liquid and its solvent properties render it difficult to seal off properly, particularly where it is to be subjected to changes in pressure, as it will then penetrate unbelievably small openings.

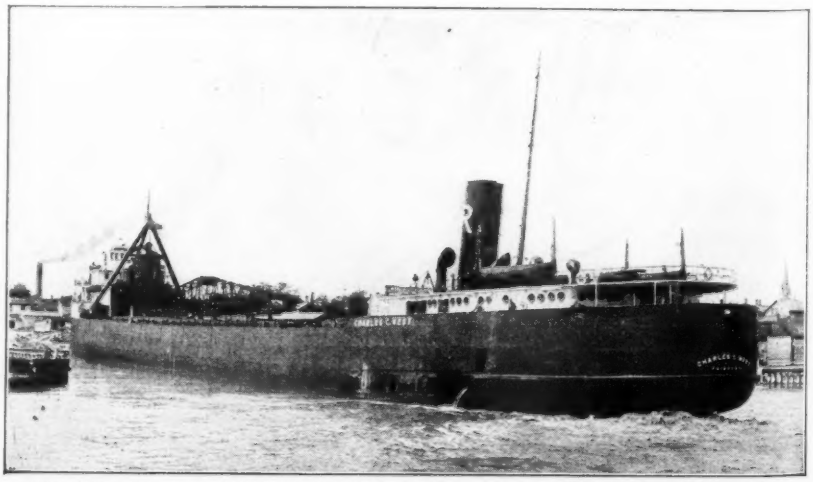
A characteristic level assembly is shown in the illustration, which provides for bottom illumination of the bubble. It consists of a curved lens of glass sealed into a metal case which is connected by a tube to a reservoir, the top of which is formed of a corrugated metal diaphragm, movable inwardly or outwardly by a thumb-screw, this action forcing in or withdrawing liquid from the level case, altering the size of the bubble. All joints being of metal, except those between the lens and the case, they may be readily sealed by soldering.

In the first experiments with this instrument, a variety of sealing devices and cements were tried with indifferent success. Pressure joints could not be made tight enough and cements or plastic fillers were attacked by the liquid. Finally it was decided to coat the glass with a metal and solder this joint in the same manner as the others.



Spherical level vial in which the lens was joined to the metal by soldering as explained herewith

Metallic tin was sprayed on the edge of the glass lens with a metal spray gun and this tin adhered very firmly to the



The lake steamer with its unloading equipment stowed on deck. When the conveyor boom swings out, material is fed to it by bucket elevators on the ship

NEW AUTOMATIC PERSONAL SERVICE MACHINES THAT TELL PRIVATELY YOUR WEIGHT AND FORTUNE FOR A PENNY . . . .

With pardonable pride we announce the crowning achievement of twenty years of concentration on the problem of making a penny actuated personal weighing scale of real accuracy, that would give the weight and fortune printed on a convenient ticket and embodying all features necessary to long uninterrupted accurate service to the public. It is the new International Ticket Scale, and truly, "Nothing of its kind is so fine."

Soon you will see it everywhere, in drug, cigar and other stores, in waiting rooms, and on platforms of transportation lines, in amusement parks, in theatres, and in those thousands of other places where you can conveniently use them.

ACCURATE WEIGHT OR YOUR MONEY BACK

The new International Ticket Scale embodies dozens of advanced improvements, probably the first of which is the fact that the scale is so constructed that if it cannot give your accurate weight printed on the ticket, it will return your penny.

INTERNATIONAL IS CARE-FREE

The sign "Out of order" will seldom appear on International Scales. Children jumping on their platforms will do them no harm, thanks to an ingenious shock absorbing device. Inclement weather cannot damage them. The supply of tickets will rarely be exhausted because the scale holds 10,000 tickets which may be added to at any time. But for those rare occasions when something does go wrong, a national service organization with service men in every town of importance in the United States, is ready to put the International Scale in perfect shape within twenty-four hours.

MANY PATENTED FEATURES

The essential improvements in the International Ticket Scale, including the ticket, "as distinctive in design as the scale itself," the printing mechanism, the self-inking ribbon, the balanced platform, the shock absorbers, to name just a few, are exclusive with International, and fully covered by strong patents.

NATIONAL ADVERTISING

The patronage which International Scales will win for themselves will be maintained by aggressive consumer advertising in a campaign embracing the major consumer advertising mediums.

•

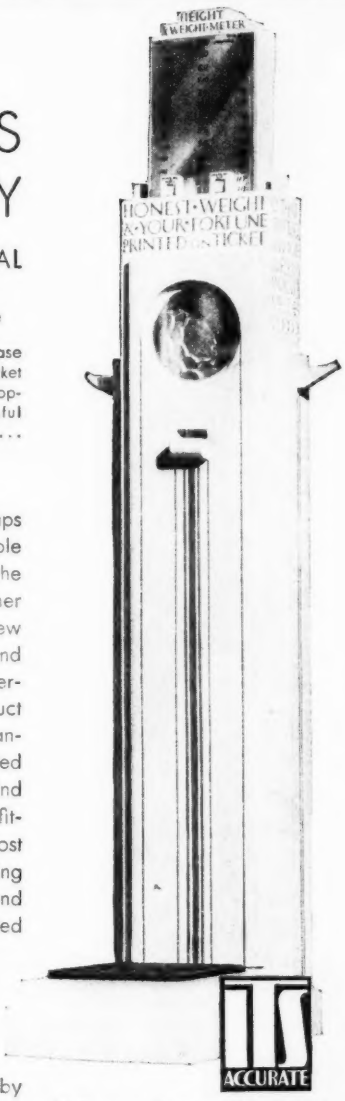
A BUSINESS OPPORTUNITY

THE NEW INTERNATIONAL TICKET SCALE

A private personal weighing service

Exclusive territorial franchise for the purchase and operation of chains of International Ticket Scales are now being negotiated. Your first opportunity to enter an outstandingly successful division of the Automatic Merchandising Field . . .

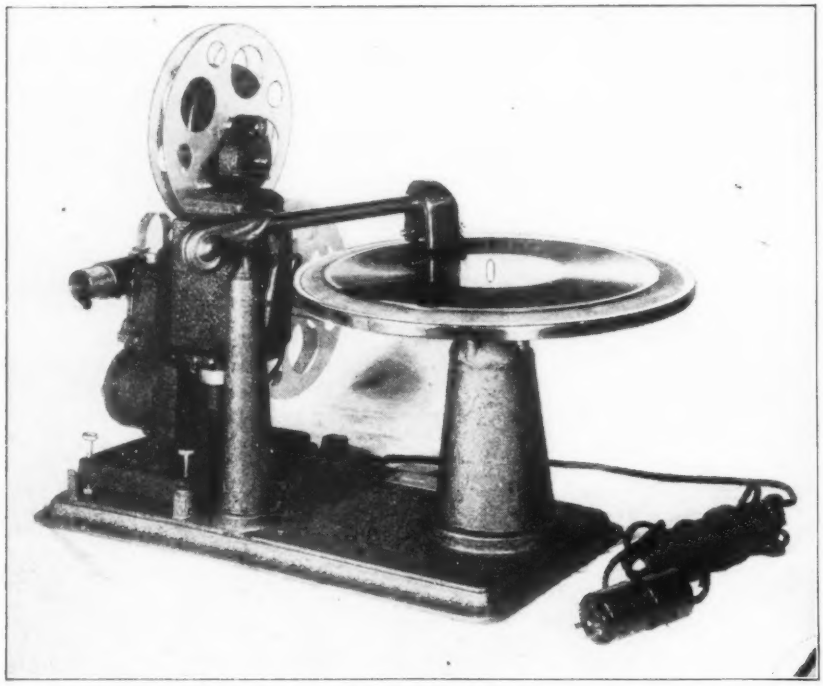
•



Did you weigh yourself today? Perhaps you did not, but literally millions of people did. Tons of pennies are dropped into the familiar penny scales in drug and other stores each day. ● Now comes a new and better scale that prints the weight and fortune on a ticket. It gives a private personal weighing service. It is the product of twenty years of experience in the manufacture and operation of penny actuated scales. ● Its slogan is "Nothing of its kind is so fine," and we might add, so profitable. In appearance the finest and most distinctive of scales. The scale and printing mechanisms are built on time-tried and approved principles refined, perfected and simplified for faster, more positive operation and greater accuracy. If you owned a chain of these scales working for you day and night, you would have a steady sure source of income, unaffected by economic changes, by poor business, or by other unfavorable factors. Each scale need be seen infrequently. You would have a business practically without overhead, with no credit problem, with no administration expense, and with the minimum of working personnel. ● The first to place International Scales on location will reap an unusually rich harvest. Those now in a position financially to secure exclusive franchises for important cities, will look at the future with eyes that are unafraid. The earnings in this business, as high as 47% annually on the investment, will also attract those with a few thousand dollars, who desire the maximum return from their investment, and who are willing to devote a small amount of their own time to their care. ● Full details concerning all phases of the operation of chains of International Ticket Scales, are given in a booklet which we will be glad to send on request to any financially responsible person. Simply write Dept. 108; International Ticket Scale Corp., 17 East 45th St., New York, N. Y.

International TICKET SCALE CORPORATION

17 EAST FORTY-FIFTH STREET, NEW YORK, N. Y.



A new set-up for the amateur "movie" enthusiast: a "talkie" phonograph record synchronized with the picture film as it is run through the projector

glass. The lens was then easily soldered into the case with ordinary tin solder.

Another method which has since been used is to coat the edge of the glass with silver, making use of any of the mirror silvering processes. The silver is deposited tightly on the glass if the work is properly performed and the joint may readily be made liquid proof. The writer has also joined glass to metal by first plating the glass with platinum, the process consisting of wetting the glass with a solution of platinum chloride and heating in an open flame, which drives off the water and chlorine, leaving a mirror-like deposit of metallic platinum. In all cases the deposit of tin, silver, or platinum is so firmly attached to the glass that joints as described above may readily be hermetically sealed.

Conquering Pulpwood Fires

MONITOR nozzles are a recent development in fire protection as applied to the huge piles of pulpwood logs held in outdoor storage at paper mills. Distributed at frequent intervals around the edges of each pyramid of timbers, the nozzles afford a means of flooding a fire with water the instant the outbreak is discovered.

The new form of equipment is superseding portable hose lines which had to be dragged into position and coupled to fire plugs with serious loss of time. The monitor nozzle is always ready for use. Located in a fixed position, on the ground or on a tower, and connected with high-pressure water mains, the nozzle may be placed in action within 60 seconds. When a stream is turned on, the water has a flow of a thousand gallons a minute. Each nozzle is adjustable as to slant and direction. If a second stream proves necessary it can be started from another nozzle. The whole process is completed in less time than would be required for a watchman to summon aid and drag a hose line to a hydrant.

When ordinary fire hose is used, the fighting of fire in a pulpwood pile is a difficult proposition. The loosely piled logs prevent firemen from scaling the sides of the pyramid, and the streams must be directed from the ground. In the case of a fire near the summit of the pile the water does not reach the blaze, because of the height of the mass and the sloping sides. A single pyramid is likely to cover a full acre of ground and reach 80 feet or more into the air. The contents may be as much as 20,000 cords of wood, valued at 300,000 dollars.

The air-dried surface of a pulpwood pile is easily set on fire by a spark. When the blaze is once started it is carried into the heart of the pile through the agency of embers dropping through crevices between the loose logs. Water thrown on the surface is shed from the sloping sides and little of the flood reaches the internal flames. In this situation the fire eats more and more deeply into the mass, causing total loss. Paper makers feel that the fire which gets a good start before water is applied presents a hopeless task for the fire fighters.

The quick action permitted by the monitor nozzles enables one man to fight such a fire more effectively than a small army equipped with hose, since the one-man fire brigade does not lose time in waiting for other workers to answer his alarm. His nozzle is at work before assistance could reach him. Various incipient pulpwood fires have been stopped by the new installations.

"Talkies" in the Home

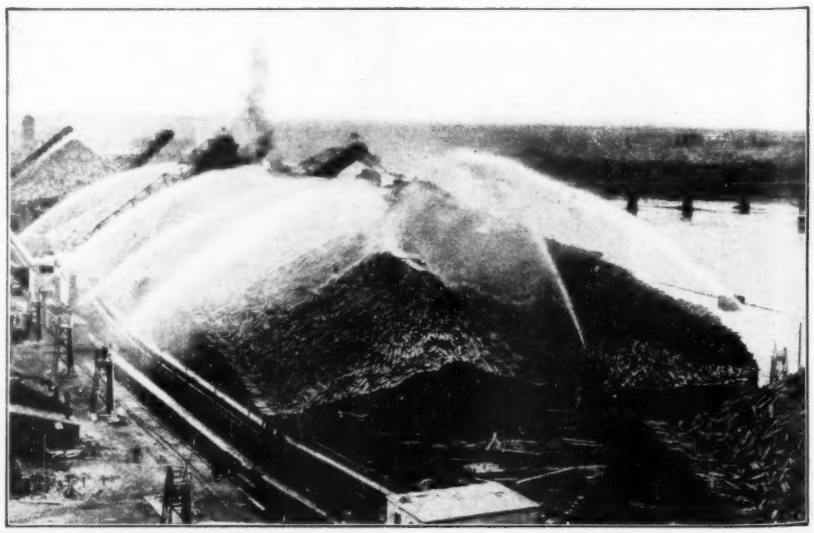
IT is now possible for the amateur motion picture enthusiast to have talking motion pictures in the home, just like those he sees in the theater. The De Vry Corporation of Chicago, Illinois, recently announced that they are ready to supply the public with a standard 16-millimeter motion picture projector geared to a phonograph record turn-table equipped with an arm and electric pick-up. From the latter, the modulated electrical currents are fed through a radio amplifier to a loud speaker. The fact that the turn-table and motion picture projector are geared to the same shaft forces absolute synchronism of sound and picture.

Since it is quite obvious that an installation of this type would be useless without further co-ordination between motion picture and sound record production, the company that puts out the apparatus has a library of films and their accompanying records which will be issued monthly so that there will be a constant supply of new entertainment.

Writing Japanese with Roman Alphabet

THE use of Roman characters in Japanese writing has been criticized and defended for a sufficient number of years to

(*Please turn to page* 376)



Huge piles of pulp wood such as this, at paper mills, often ignite spontaneously. Fires may be quickly controlled by means of the tower nozzles

The Winged Hand will

Move— Convey— Store—

your materials more
Economically, Systematically,
Speedily and Safely
than any other system

Ask

StueBing COWAN

"The Material Handling Specialists"

for their free recommendations. There is a system, a method and a type best suited to your particular and specific needs. They will gladly tell you exactly what it is—how much it will save you and what you will accomplish by its use.

Don't buy merely a truck—buy the type size and style built specifically for the work you have.

The Stuebing Cowan Co.
335 East Court Street
CINCINNATI, OHIO
Representatives everywhere

"As Handy as the Hand"

StueBing COWAN

SMALL INVESTMENT-BIG DIVIDEND

Lift Trucks

America should ship its goods on skid platforms
Walter C. Stuebing

STAFF

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

Planes on the Instalment Plan

PLANES can now be bought on the instalment plan, similar to that customary in the automobile business. Commercial Credit Companies of Baltimore will finance the purchase of planes provided they are of approved commercial types, and are to be flown by transport pilots. The minimum cash payment required for a retail sale is 33⅓ percent, which is somewhat more than is necessary in the purchase of an automobile, and a complete line of insurance has to be obtained. Nevertheless the announcement of the Baltimore company is significant of the practical character which the airplane industry is now assuming.

Curtiss-Caproni

THE newspapers have recently carried announcements of the formation of a new, four million dollar corporation, the Curtiss-Caproni, which unites one of the foremost American companies with one of the best Italian constructors. Mr. C. M. Keys announced that by this union of talent and finances, the Curtiss company would save several years in the development of large commercial aircraft.

Certainly Caproni has built and flown successfully airplanes which are larger than any flying in the United States to-day. Caproni employs an all-metal structure, with fabric covering. His interior wing construction with built-up dural spars is not unlike the girders of a rigid airship. The Caproni *CA.79* is equipped with four engines of 500 horsepower each. It can carry a bomb load of 4400 pounds, has a span of 78.5 feet for the upper wing, 116 feet for the lower wing, a total wing area of 2360 square feet and a maximum speed of 129 miles per hour.

Of particular interest in this design is the fact that the lower wing is much longer than the upper one. It is difficult to say what the aerodynamic advantage of such an arrangement may be. There are two engines in tandem at the center and one engine on each side, mounted on the lower wing. The design differs radically in appearance from American practice.

Caproni shows an even larger monoplane, equipped with three 1000 horse power water-cooled engines. The photograph of the wind-tunnel model of this giant shows remarkably clean lines, and a very well worked out wing trussing. Finally, Caproni has in process of construction what is undoubtedly the largest plane in the world. This is designed for either military or commercial use, is equipped with six 1000 horsepower engines, and has a gross weight of 55,000 pounds. It will be interesting to see the construction of these huge craft in our country. They may be of real value in the air transport work of the future.

The Aircraft Diesel Engine

THE Packard Motor Car Company has recently tested successfully in flight an aircraft Diesel engine, seven cylinder air-cooled, developing over 200 horsepower and weighing only a little over three pounds per horsepower. The Diesel engine offers great advantages for aviation by its elimination of the ignition and carburetion systems and by making possible the use of heavy fuels, non-inflammable in character. The Packard tests show that the aircraft Diesel has passed from the phase of speculation to that of practical experimentation. It is therefore very interesting to read the paper submitted to the Society of Automotive Engineers by Captain L. M. Woolson, Research Engineer of the Packard Company.

We show the typical indicator diagrams of an ordinary gasoline engine, a low-speed Diesel engine, and a high-speed Diesel.

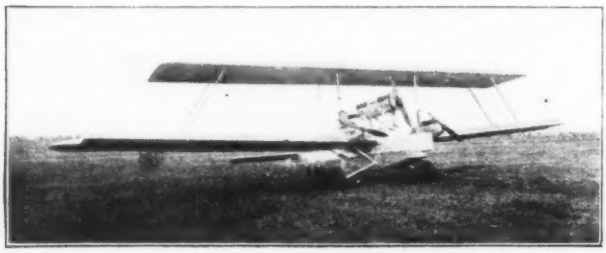
In the ordinary gasoline engine, the fuel enters the cylinder with the charge of air, the mixture is compressed, and is ignited by an electric spark at the end or a little before the end of the compression stroke. The explosion is very rapid, and the gas rises to its maximum pressure while its volume remains practically constant. It then does its work on the expansion stroke. The maximum pressure developed in the gasoline engine is of the order of 550 pounds per square inch.

In the stationary Diesel we find that low speeds of 200 or 300 revolutions per minute are generally used. In the low-speed Diesel, the air is compressed insi the cylinder just as in the gasoline engine, but solid fuel is injected about 10 degrees before the end of the compression stroke and the injection continues until about 32 degrees past top dead center. Generaily, some form of hot bulb is used to secure combustion, and the maximum pressure is no greater than in the gasoline engine. Combustion takes place at constant pressure, as can be clearly seen from the diagram. The low-speed Diesel has a lower mean effective pressure than the gasoline engine, and this, coupled with its slow speed, makes it totally unsuitable for aircraft work—the weight of the power plant alone would prohibit its use.

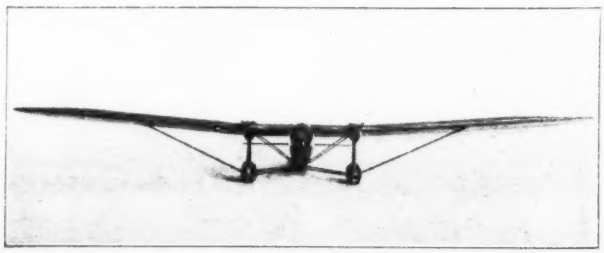
Therefore we are driven to the conclusion that an aircraft Diesel engine must be of the high-speed type, with revolutions per minute in excess of 1500. In the high-speed Diesel, to ensure complete and smokeless combustion, the injection of fuel must start early, about 50 degrees before dead center. The compression at the end of the compression stroke must be 500 pounds, or equal to the maximum pressure developed in the gasoline engine. There is no need of a spark or even of a hot bulb, the high pressures and temperatures producing auto-ignition. The maximum pressure rises to the enormous value of 1200 pounds per square inch. The compression ratio is 14 to 1, as compared with the compression ratio of 6 to 1 in the gasoline engine. The efficiency is accordingly much higher than in the gasoline engine.

Since higher efficiency is added to its other advantages, one would assume the aircraft Diesel to be absolutely the ideal power plant for all aircraft. There are, however, certain difficulties.

The gasoline aircraft engine has been greatly reduced in weight per horsepower, but it has to withstand a maximum pressure of only 500 pounds per square inch. How can the Diesel engine cylinder with its maximum pressure of 1200 pounds be kept within reasonable weight limits? The answer is that by careful design and the utilization of the best possible materials, the Packard aircraft Diesel weighs less than three pounds per horsepower. As a typical example of what the Packard engineers did, light cast alloys have been eliminated as unsuitable for meeting high al-



A four-engined, 2000 horsepower biplane designed by Caproni. Note the relative lengths of the two wings



A wind-tunnel model of a monoplane of Caproni design. The lines of this plane are exceptionally clean-cut

If You Want Extreme Ease of Manipulation and Finer Control

This Push Button Control will Give it to You~

Besides the instantaneous action obtainable, the controller parts have greater life with the Push Button Control.

A push button pendent station is provided with two buttons, the top one raises the load, the bottom one lowers it. The movement up or down continues only so long as the operator holds the button in, when the pressure is released the current is automatically interrupted.

Attached to the control box is a puller handle which is connected to the hoist by a steel cable. This feature is provided for pulling the load along the beam, a feature making this operation easier than pushing on the load or when there is no load, pulling on the load hook. The puller cable and handle always being in a fixed position makes it always accessible for either operating the hoist up and down or pulling it back and forth on the track.

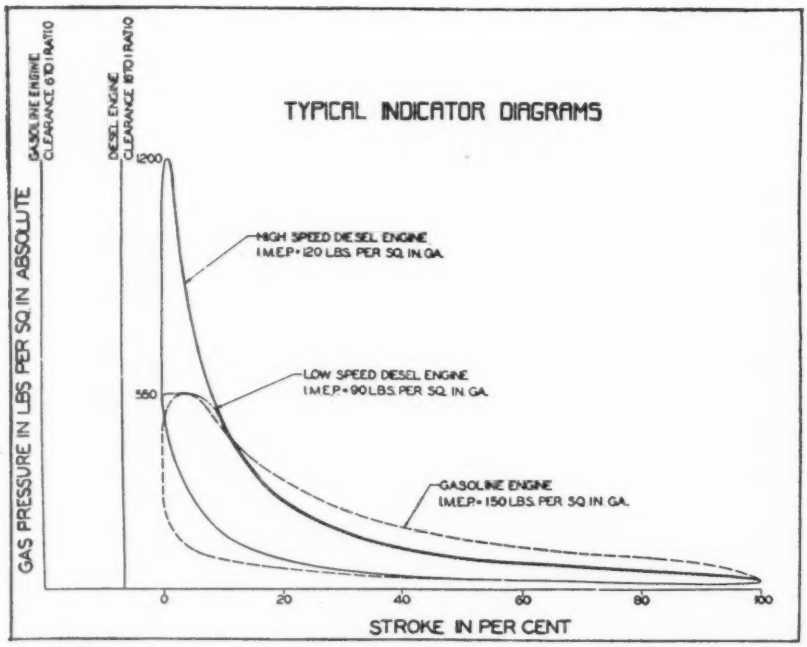
But this is only one of the many features of Northern Hoists.

Write for our bulletin EH 105F

NORTHERN ENGINEERING WORKS, Detroit, Mich.

Offices in all principal cities.
"Member of Electric Hoist Manufacturers Association"

NORTHERN
Push Button Control
HOISTS


TYPICAL INDICATOR DIAGRAMS
GAS PRESSURE IN LBS PER SQ IN ABSOLUTE
GASOLINE ENGINE CLEARANCE 6 TO 1 RATIO
DIESEL ENGINE CLEARANCE 15 TO 1 RATIO
1200
560
HIGH SPEED DIESEL ENGINE I.M.E.P. = 120 LBS. PER SQ. IN. GA.
LOW SPEED DIESEL ENGINE I.M.E.P. = 90 LBS. PER SQ. IN. GA.
GASOLINE ENGINE I.M.E.P. = 150 LBS. PER SQ. IN. GA.
0
20
40
60
80
100
STROKE IN PER CENT

Typical indicator diagrams for an ordinary gasoline engine, a low-speed Diesel, and a high-speed Diesel. The text starting on page 356 describes these

ternating stresses. Captain Woolson does not state this in his paper, but more expensive machined parts in steel have probably taken the place of the castings.

Captain Woolson does not deal with the injection of fuel. An enormous amount of research has been done by several agencies on this problem. Suitable high-pressure pumps and the right kind of injection nozzles have already been developed.

The gain in simplicity by the use of the Diesel is shown by the following facts:—In the typical gasoline engine, there are two separate magnetos, 18 ignition wires, 18 spark plugs, and an ignition switch. There is an aggregate of perhaps 1000 individual parts making up the ignition system. In the Diesel, with its automatic ignition, no additional parts of any kind are required. Continuous ignition is assured just as long as the engine is operating. Furthermore, the ignition system of each Diesel engine cylinder is entirely independent of the ignition conditions in any other cylinder.

Now compare the fuel supply systems. The conventional nine-cylinder gasoline engine is dependent on perhaps a single carburetor—at best on a triple-barrel carburetor. Even with the triple carburetor, there are only three independent carburetion systems, the failure of any one of which will result in the loss of one third of the operating cylinders. In the Diesel, each cylinder receives fuel from an independent pump, thus making it impossible for a clogged fuel line to impair the performance of more than one cylinder.

Comparing fire hazards, we find that the fire point of gasoline is below zero, Fahrenheit; for the heavy fuel used in the Diesel it is 175 degrees, Fahrenheit. In the Packard tests, lasting over a year, there were innumerable cases where fuel lines leaked or were even broken off. Not a single fire resulted.

Heavy fuel oil is much cheaper than gasoline. With aviation gasoline at 19.8 cents per gallon, the cost is 1.7 cents per brake horsepower hour. With the Diesel engine, the corresponding cost is 0.35 cents per brake horsepower hour or about one fifth as much.

Another interesting point in the Diesel is the fact that it will operate successfully in any position. All engines using carburetors are dependent upon gravity as far as correct functioning of the carburetor is concerned. With the Diesel, worry as to position in a steep climb or in stunting is entirely eliminated.

We only hope that other aircraft engine manufacturers will energetically follow Packard's example and make the transition stage from gasoline to heavy fuel-oil as brief as possible.

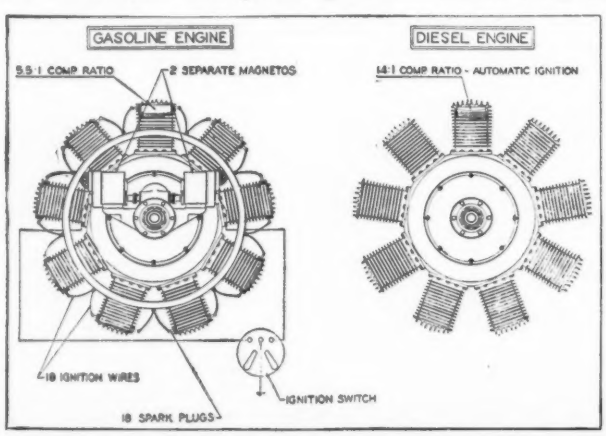
To Panama by Air

COLONEL CHARLES A. LINDBERGH has become technical adviser to Pan-American Airways and, by piloting a mail plane over the "Lindbergh trail" to the Panama Canal Zone, officially opened that route. This will be the fourth and longest route of the Pan-American Airways. The course is through Havana, British Honduras, Nicaragua, Costa Rica, and ends in Cristobal. In some cases as much as two weeks will be saved on South American mail. The trip from Miama, Florida, will be made in a twin-engined Sikorsky amphibian, which is undoubtedly one of the outstanding American planes of to-day.

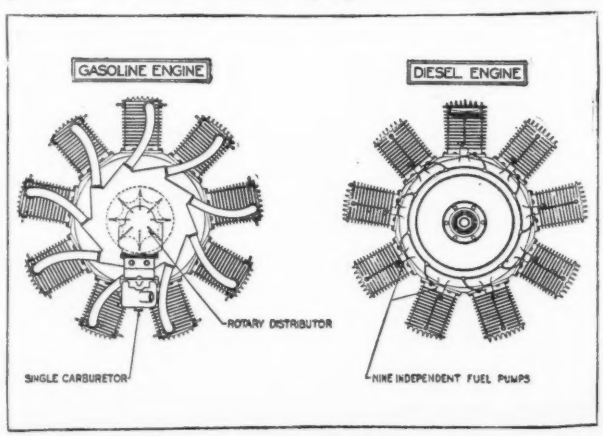
We are indebted to the Sikorsky company for the appended photographs and latest data.

The Sikorsky *S-38-B* is powered with two Pratt and Whitney Wasps, of 410 horsepower each. It can fly fully loaded, and even climb to some extent, with one of the engines out of commission. The weight empty is 6000 pounds. The useful load is 4000 pounds. With this load, the maximum speed is 124.5 miles per hour, and the initial climb 880 feet per minute. The useful load is distributed as follows: Crew (two), 340 pounds; equipment, 125 pounds; gas for five hours' flying (180 gallons), 1080 pounds; nine passengers, 1530 pounds; baggage and mail, 800 pounds. The total pay load is thus 2330 pounds. The total wing area is 720 square feet, and the maximum wing spread is 71 feet, eight inches.

By means of a simple, manually operated, hydraulic control, the landing wheels, separately or together, can be raised in 30 seconds, and lowered in 40 seconds. If the pressure in the landing gear oil-supply tank is kept at 25 pounds by the small hand pump installed as standard equipment, the landing gear is pushed down automatically. When retracted, the wheels lie horizontally against the lower surface of



Gasoline engines require a comparatively complex ignition system, while the Diesel is automatically fired

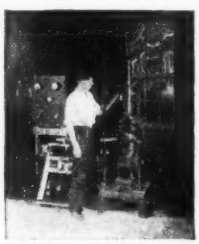


The fuel system on an aircraft gasoline engine is shown at the left above, and that of a Diesel at the right

WHAT WESTINGHOUSE IS DOING IN RESEARCH

WESTINGHOUSE ENGINEERS ARE STUDYING LIGHTNING IN ITS STRONGHOLD

Waging War Against Lightning



Lightning, the raider of power lines, each year exacts a heavy toll in lost time and damaged equipment. In the flick of an eyelash, or less, it stages its attack, vanishes, and leaves no trace except a trail of waste and ruin which must promptly be repaired to maintain standards of service.

Long ago Westinghouse declared war against this elusive plunderer when A. J. Wurts, a Westinghouse engineer, developed his famous lightning arrester.

Now science has placed in the hands of engineers new devices for repelling this invader.

Today, in the mountains of Tennessee, Westinghouse has established an outpost of engineers armed with amazing new machines swifter than lightning itself to gather records to serve as foundations for protective devices.

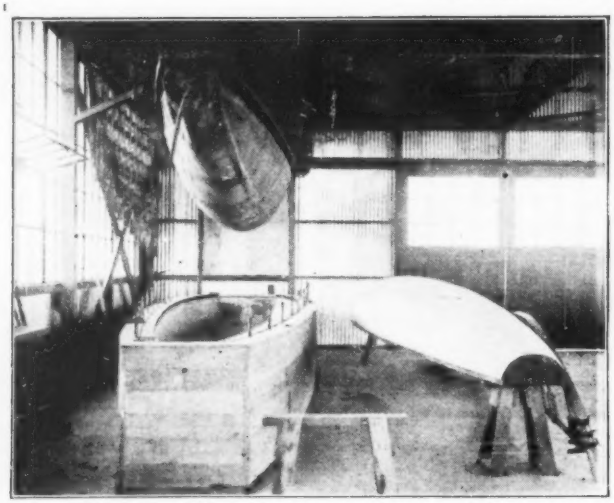
The new Norinder oscillograph catches the flash of any lightning stroke within its range. The smallest spark or the hundred-million-volt explosion leaves its autograph for experts to study and compare. Along with this device sensitive Osisos record line disturbances and indicate the position and magnitude of thunderbolts. Klydonographs record the shocks received by transmission lines. Every important detail is observed and reported.

Thus Westinghouse, pioneer in the development of practical methods of generating and transmitting alternating current, is now developing new ways to protect power transmission . . . a basic asset to the world of business and industry.

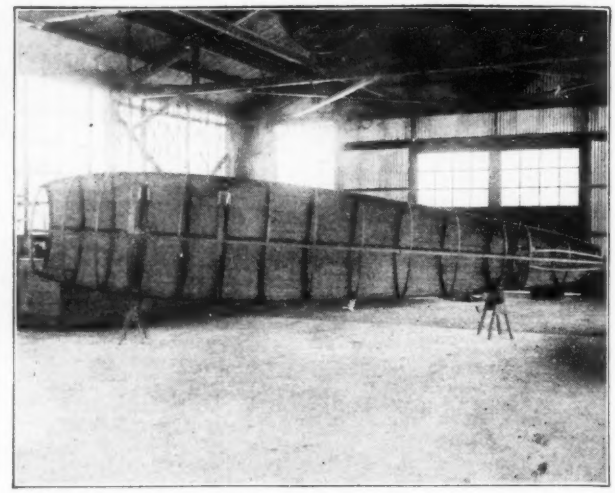
The Sign of a Westinghouse Dealer

Westinghouse Electrification Appliances Apparatus Wiring

Westinghouse



Part of the equipment for the fuselage construction system described. The air bag is shown suspended



After a fuselage half shell is completed, it is applied to a series of spruce rings of varying cross section

the lower wing, projecting forward about half their diameter. An excellent emergency braking action is obtained with this type of landing gear when running on the ground. By operating the single throw valve, the airplane may be lowered smoothly until the keel of the hull scrapes the ground, effectively stopping the plane.

The forward compartment of the hull is four feet, six inches long, three feet, six inches wide, and two feet high, and has a capacity of 30 cubic feet. In it are stored the marine equipment including one 35-pound collapsible ground anchor and line and one sea anchor with oil tank. The bulkhead behind this compartment is solid but through a small hatch in the deck the equipment is accessible to one standing in the second compartment. The second compartment is four feet, two inches long, four feet, ten inches wide, three feet in mean height, and has a capacity of 52 cubic feet. This space is provided for baggage or mail.

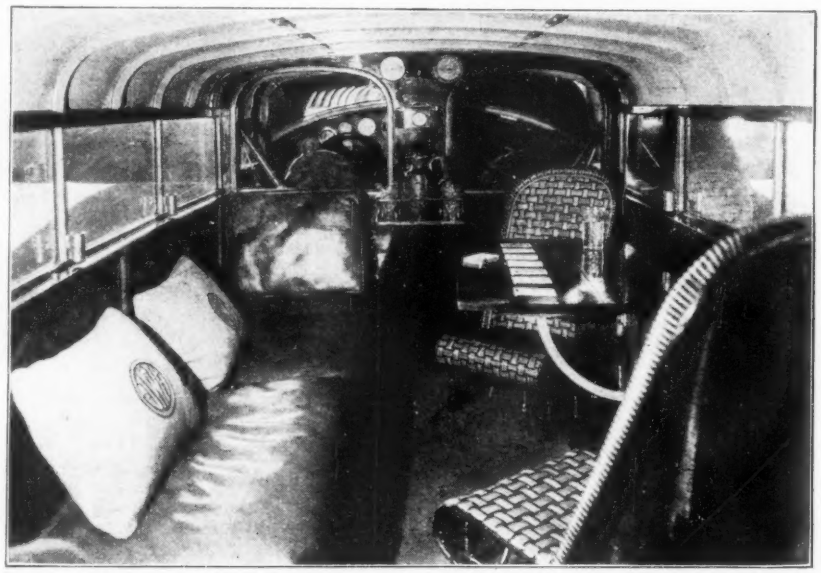
Aft of the baggage compartment is the pilot's cabin, furnished with two seats, side by side, easily adjustable in height by the occupant without moving from the seat.

Novel Fuselage Construction

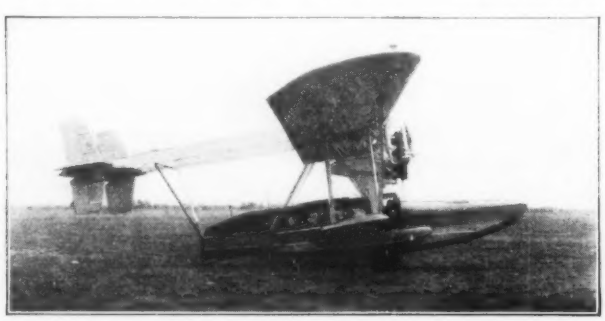
THE Lockheed *Vega* is one of the best known commercial planes of the day, with exceptional streamline and speed qualities. Its beautiful cantilever wing contributes largely to its speed, complementing the monocoque type of body, which is as nearly perfect in streamline form as it is possible to make a fuselage in which an engine has to be mounted.

The monocoque type of fuselage has always been recognized as aerodynamically superior to all other types. It offers certain advantages in weight-strength ratio because of the elimination of non-structurally acting fairing. It also offers the advantage of leaving the interior of the fuselage completely unobstructed, which increases the comfort and safety of the passengers, and provides plenty of cargo space. In a paper presented before the Society of Automotive Engineers, Gerard F. Vultee describes in detail a novel form of monocoque construction developed by the Lockheed Company.

The conventional method of building a monocoque fuselage consists, first, in constructing a form of the required shape. A layer of veneer is fastened over this form. The first layer usually consists of narrow strips one sixteenth to one eighth of an inch in thickness, laid diagonally or wrapped around the form. Each strip is separately



A view of the interior of the passenger cabin of the Sikorsky *S-38-B*, the type employed on the Lindbergh Trail to the Panama Canal Zone, recently opened



Side view of Sikorsky *S-38-B*. Note size of cabin

Quartering front view, showing the two motors

A DREAM REALIZED

NEW YORK LIFE INSURANCE COMPANY

(INCORPORATED UNDER THE LAWS OF NEW YORK)

A MUTUAL ORGANIZATION, FOUNDED IN 1845

EIGHTY-FOURTH ANNUAL STATEMENT

TO THE POLICY-HOLDERS:

Our Eighty-fourth Annual Report has been verified and is being filed with various governmental authorities. May I point out to you, the people chiefly interested, some of its salient facts?

As policy-holders you paid the Company last year in round figures $256,000,000.

The Company paid to you and to beneficiaries $156,000,000.

That left us about $100,000,000.

Our net reserves increased during the year $100,000,000.

We put that $100,000,000 in our reserves.

You may ask, what are reserves?

Broadly speaking, they are funds set aside from which future liabilities are to be met.

We put that $100,000,000 in reserves at the close of the year for that specific purpose.

A policy of Life Insurance is almost exactly like a bond. It will mature some day. Nearly all bonds mature at a definite date. Most policies of Life Insurance mature at an indefinite date, but all will mature, in some form, within a limited period of years.

A sound bond is protected by a Sinking Fund—from which the bond is to be redeemed at maturity. The Sinking Fund is accumulated by yearly deposits.

That $100,000,000 was our 1928 deposit, our addition to the Sinking Fund for that year.

The law requires it. If we had failed to make or could not make that entry (deposit) we would soon be declared insolvent by the Insurance Departments and the Courts.

The reserve increase for 1928 was large, but no larger than the law requires.

That we shall redeem all our bonds (policies) as they come due is certain. You know that.

The other income of the Company was sufficient to pay all the expenses of acquiring $900,000,000 of new business in 1928, the care of about $6,500,000,000 of old business, taxes, $6,700,000, the care of invested funds, the maintenance of other legal reserves and a sum sufficient to pay in 1929 $8,000,000 more in dividends than we paid in 1928, and to increase the general surplus by $4,000,000.

In addition the Company loaned you on the sole security of your policies $52,700,000.

These are round figures, calculated to give you merely an outline sketch of the Company's activities in 1928.

SAVING YOUR MONEY

How much of the $156,000,000 we paid you or to beneficiaries during 1928 and how much of the $52,700,000 loaned you during that year will be lost because unwisely invested? That is a very important question. It goes to the very heart of the usefulness of Life Insurance. To save money by investing it soundly is difficult.

Even men of experience frequently make mistakes.

I do not overstate the truth when I say that few people having small amounts of money to invest do it wisely.

REMEMBER

You can leave the proceeds of your insurance with this Company in trust for your beneficiaries or you can leave any cash due under your policy and the Company will hold it, guaranteeing your principal and not less than 3% interest.

On all such funds we will pay in 1929 (as we have done for some years) 4.6%.

In 1928 you left with the Company in this way under various accounts $28,000,000.

Your total under these accounts on January 1, 1929, was $70,000,000.

That $70,000,000 is not just a deposit. It is mingled with the Company's entire assets and is a part of the Company's liabilities. It is backed, as all our liabilities are, by $1,500,000,000.

Finally study the balance sheet. There you have the facts about our financial condition, while above you have a picture of the new Home Office: "A Dream Realized."

Dividends to Policy-Holders in 1928 . $58,600,000

Dividends in 1929 67,100,000

BALANCE SHEET

ASSETS		LIABILITIES	
Real Estate Owned and First Mortgage Loans on Farms, Homes and Business Property	$564,502,256.85	Reserves—ample with future premiums and Interest to pay all insurance and annuity obligations as they become due	$1,340,100,132.87
Bonds of the United States, Other Governments, States, Cities, Counties, Public Utilities, Railroads, etc.	641,944,719.68	Dividends Payable to Policyholders in 1929	67,148,446.00
Preferred and Guaranteed Stocks	31,238,610.00	All other Liabilities	7,973,047.98
Policy Loans, Cash and Other Assets	297,394,761.12	Total Liabilities	$1,415,221,626.85
Total Funds for Policyholders' Protection	$1,535,080,347.65	General Contingency Fund	119,858,720.80
		Total	$1,535,080,347.65

Show the "Dream" and the balance sheet to your neighbor.

New York Life Insurance Company

By DARWIN P. KINGSLEY, President

Front view of the Verville Air Coach described in these columns. Note in particular the streamlined sponsons projecting from the side of the fuselage

fitted and fastened to the form by means of tacks, clamps, glue, or some binder. After the first layer has been applied, a second layer is assembled, the grain running at an angle to that of the first layer. Each strip is individually glued and is tacked or clamped to the first layer in an effort to produce, as nearly as possible, a homogeneous structure. A fuselage of two or three plies is completed in this way, the final layer usually being covered with fabric to help in binding the structure together. The process is laborious and expensive, although it gives the airplane a light, streamline fuselage.

The new Lockheed process is ingenious, and much more rapid and inexpensive.

The first step in the fabrication process is the construction of a suitable mold. The body lines are first laid out to give the required cargo space, with an elliptical center section tapering gradually to a circular section in front. A wooden form is then built to the exact shape required for one half of the fuselage body, divided on a vertical plane passing through the center line. This form is finished smoothly and made very rigid. It is then suspended with its curved surface downward in a large box. The box is filled with a good grade of concrete, which is carefully tamped to produce a smooth surface against the wooden pattern.

After the concrete has thoroughly hardened, the wooden fuselage pattern is lifted out. Thus, a reinforced concrete block is produced that has a central depression which is just the shape of one half of the finished fuselage.

To assemble a half shell, the outer layer is placed in position in the concrete mold and coated with casein glue. A coat of glue is put on the second layer, and the inner layer is put into place inside the other two. A large rubber air-bag of exactly the shape of the inside of the mold is inserted in the depression, a cover is lowered and bolted down and air pressure is applied to the rubber bag which fills the space between the plywood shell and the cover.

The actual time to complete the process is only about 20 minutes from the application of the first glue until the whole shell is under a pressure of 15 to 20 pounds per square foot. Any slight irregularities in the concrete mold are compensated for by the resilience of the rubber bag. The shell remains under pressure in the mold for about eight hours. The resultant half shell is a homogeneous piece of plywood without joints, cracks, or laps, perfectly glued and exactly streamlined.

The skeleton framework to which the half-shell is applied consists of a series of elliptical laminated spruce rings of varying cross sections, held in position by light spruce strips or longerons.

A Substitute for Control Cables

THE control cables in general use for airplanes present certain difficulties. They have a comparatively short life because single strands of the cable wear out when passing over control pulleys. The cables are susceptible to rust. The connection of cables to levers, control surface horns, et cetera, is a matter of some difficulty and is not a good mass production proposition. A German patent secured by P. Brenner suggests the subsitution for the stranded cables of several thin flat metal bands. These flat metal bands are easily fastened together at their ends by screws and nuts, connections to horns and levers become very simple, and additional short pieces of metal can be readily added where the wear is likely to be large. Provided the metal bands give sufficient flexibility they should be worth considering.

The Verville Air-Coach

ONE of the latest and trimmest additions to the cabin type of passenger carrying monoplane is the Verville Air Coach, first hand information regarding which has been received from the Verville Aircraft Company.

The Air Coach is a four-seater, semi-cantilever plane, which can be equipped with either a Warner Scarab of 110 horsepower, or a Wright Whirlwind of 200 horsepower. With the Scarab, the disposable load is 875 pounds, the speed 110 miles per hour. With the Whirlwind, the disposable load is 1150 pounds and the maximum speed is 125 miles per hour.

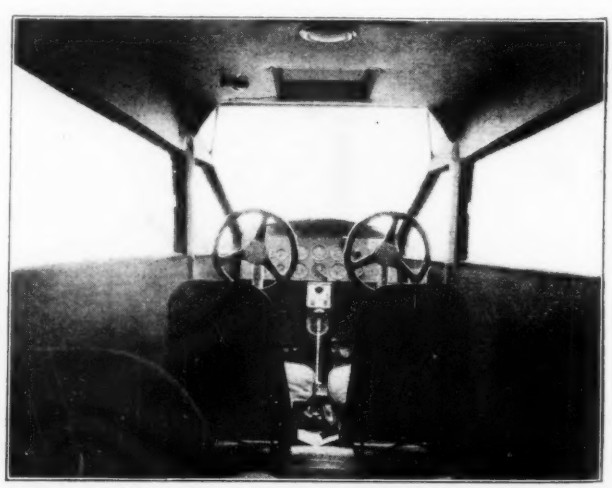
Our readers have become familiar with the conventional features of the many cabin monoplanes now on the market, so let us pick out the original and distinctive features of the Air Coach.

Two short streamline sponsons, or stubs, semi-elliptical in plan form, and 16 inches in length, project horizontally from the lower longerons in the plane of the front struts. To these the forward wing brace struts and chassis oleo struts are attached. By attaching the wing struts in this manner, parasite resistance is reduced, as compared with the conventional type of exposed strut bracing now in vogue. The landing gear struts are attached at the outer extremity of the stubs, allowing an exceptionally wide tread. The stubs or fins serve as small compartments, eight inches deep, with hinged doors on their top sides. The left compartment is used for the lighting battery, and the other for tools.

The rudder is streamlined into the fuselage, which also makes for less parasite resistance. The fin is strongly enough built to dispense with external bracing.

The wings are attached to the fuselage with trunnion type fittings. The wing struts are attached with screw terminals at the top of the struts, so that dihedral angle adjustments are readily possible. This allows the dihedral to be set for the best

The rudder of the Air Coach is streamlined into the rear of the fuselage, and the fin is internally braced



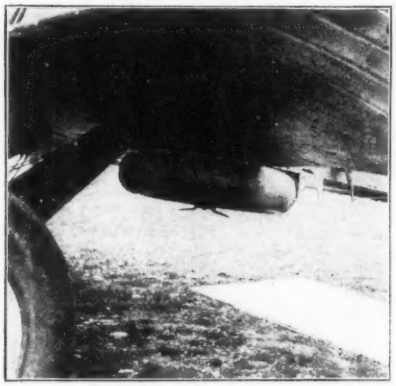
The comfortable cabin of the Air Coach is well arranged. Vision is splendid from all parts of the interior

amount of lateral stability. Wing and fuselage blend gracefully into one another. The photographs on the opposite page show the pleasing appearance of the plane.

As we have often insisted should be the case, the Verville Air Coach brings to commercial aircraft many of the speed features of the racer.

Pittsburgh shatter-proof Duplate glass is used in the windows in place of the conventional Triplex.

The four seats in the cabin are bolted to the tubular structure of the fuselage. Upholstering is of Laidlaw's broadcloth. A mat of woven automobile type is laid over the floor. There are four pockets, one on each door, and one on each side wall forward of the doors. Certainly the interior of the cabin looks very attractive and is calculated to give the best possible vision to pilot and passengers alike.



Even airplanes need spare tires on occasion, just as do the best of automobiles. Here is shown how this necessary accessory is carried under the fuselage of an army airplane. This particular photograph was taken of a plane stationed at Portland, Oregon, but army planes at fields all over the country frequently carry their spare tires in much the same fashion

Locking the Handley Page Slot

THE automatic Handley Page slot opens whenever the angle of incidence approaches too closely to the "stalling" point and thus constitutes a great measure of safety for commercial airplanes. An airplane provided with the automatic slot, being less likely to stall, is also less likely to spin. Army and navy pilots have considered this anti-spin characteristic of the slot an objection, since spinning is one of the maneuvers which they must be able to perform at will.

The Chance Vought Corporation has met this objection by applying a locking device to the slot installed on its Vought Corsair biplane, with control from the pilot's cockpit. In the course of some tests by Lieutenant C. B. Harper of the navy, the Corsair was flown to 10,000 feet altitude and deliberately put into a spin. After some ten turns were completed, the slots were unlocked by a lever in the cockpit and the plane recovered from the spin in half a turn.

Another interesting fact brought out by tests on the slotted wing Corsair is that ice formation will not affect the functioning of the slot. On one occasion a heavy layer of ice on the wing interfered in no way with the functioning of the device.

"This free book saved us $200"

MORE than 130,000 car buyers have saved money by sending for this valuable book, "How to Judge a Used Car." Filled with new pictures and new information, this book tells you how to judge a used car's condition, what speedometers tell; what code prices mean.

A better car for fewer dollars—a finer car you can drive with pride at a price lower than you believe possible—how 2,000,000 motorists saved money for themselves last year—this free book tells you all these money-saving facts, and many more.

Don't let false pride prevent you from enjoying a good six or eight this summer. The cost is small when you learn how to take advantage of big savings on today's market. This practical book, offered you for the asking, may easily, *safely*, save you $200 this Spring!

Pledge to the Public on Used Car Sales

1 Every used car is conspicuously marked with its lowest price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.

2 All Studebaker automobiles which are sold as CERTIFIED CARS have been properly reconditioned, and carry a 30-day guarantee for replacement of defective parts and free service on adjustments.

3 Every purchaser of a used car may drive it for five days, and then, if not satisfied for any reason, turn it back and apply the money paid as a credit on the purchase of any other car in stock—new or used. (It is assumed that the car has not been damaged in the meantime.)

© 1928 The Studebaker Corporation of America

130,000 people have saved money by mailing this coupon!

THE STUDEBAKER CORPORATION OF AMERICA
Dept. 254, South Bend, Indiana

Please send me my copy of your valuable free booklet, "How to Judge a Used Car."

Name.....

Street.....

City.....*State*.....

STUDEBAKER

Builder of Champions

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Poison Gas Worse Than A White Elephant

A LARGE quantity of war-time gas recently discovered in a disused dynamite factory near Cologne has been identified as "Blue Cross" gas, which is difficult to destroy with safety. It is considered too dangerous to be taken to sea. The Inter-Allied Commission was communicated with some time ago relative to its disposal, but, as no safe method of getting rid of the unwanted gas could be suggested, it was allowed to remain at the factory. Its interment in a deep underground chamber constructed of steel and concrete has become necessary as the city authorities intend to build houses for their officials in the neighborhood.

Synthetic Tannin Needed

ASIDE from the regrettable loss of beautiful trees and toothsome nuts, the blight which has doomed the chestnut tree in America strikes uncomfortably close to the leather industry, which depends on the wood for vegetable tannin. C. R. Oberfell, writing in *Chemical and Metallurgical Engineering* surveys the future of this material:

"The chestnut tree is doomed, which is a national calamity; but we do not think it will affect the supply of tannin extract for from 20 to 30 years. The disease does not damage the wood—it simply girdles the trunk between the bark and the wood, thus throttling the tree. As long as the wood is sound it is suitable for extract.

"Chestnut wood does not decay rapidly, so aside from the high fire hazard in dead timber, it is believed by many in the extract industry that most of the trees now dead will stand and be available for extract for from 15 to 20 years. Although the blight is now progressing there are still large stands of timber not affected, from which one will see that there will be chestnut extract for many years to come.

"Naturally the situation is serious from a long range viewpoint. Combination sole-leather tannages, that is chrome and vegetable liquors in which the amount of vegetable tannin required is much less than in full vegetable tannage, give more promise than straight chrome of helping out the situation. It might be said that the disadvantages of chrome sole leather are partially offset by this combination process. However, the United States might as well be dependent on imported extract as upon imported chrome salts during a national emergency; and during peace times vegetable extracts will always be obtainable, although not as cheaply as our domestic chestnut.

"There is another possibility which may eventually provide the final solution—that is, synthetic tanning materials. We have had them for 14 years, most of them bad, and only a few partially successful, but the possibility exists. The problem has not received the intensive research which spells success. These materials do not "fill" or pack in between the fibers, giving firmness, wear, and water-resisting qualities to sole leathers, but it is probable that a suitable synthetic tanning material will be developed for the preliminary or pretannage, and the "filling" process can be accomplished by the use of so-called "spruce extracts" made from the refined waste liquors from pulp mills. Sufficient study along this line has been done to demonstrate that when economic pressure comes this will be the nature of the final solution."

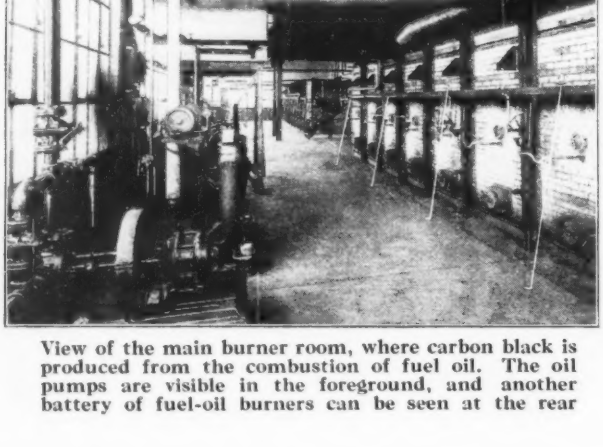
Manufacturing Carbon Products

CHEMISTRY long since established the fact that the brilliant diamond is composed of the same element—carbon—that makes up the drab lump of coal. Carbon, in its lowlier form, finds industrial application in many forms which are none the less essential because of their obscurity. Carbon electrodes are vital to many electro-metallurgical operations; carbon brushes are universally used in electric motors, tons of carbon black are employed in rubber compounding and paint manufacture; the familiar dry battery and arc lights both use carbon electrodes; and many other specialties such as telephone disks, lightning arresters, turbine packing rings, telephone back plates, electrical contact points, and elevator contact plates use large quantities of especially fabricated forms of carbon.

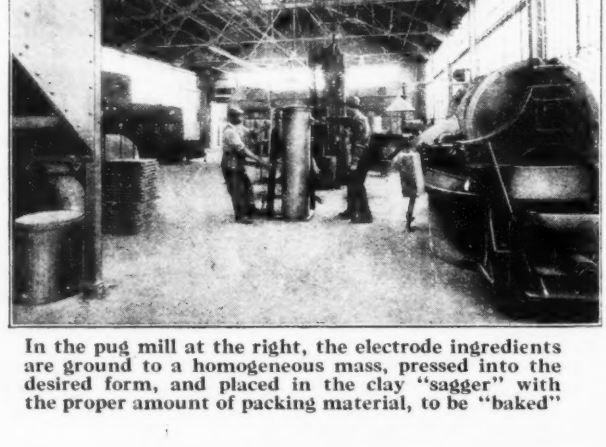
There has recently been completed, at Fostoria, Ohio, a new and splendidly equipped modern plant of the National Carbon Company for the production of carbon products, which is illustrated on this page through the courtesy of R. S. McBride and *Chemical and Metallurgical Engineering*.

"The manufacture of carbon products requires a proper blending of the raw materials, accurately controlled processing, and highly specialized mechanical technique in finishing, in order that the final result may be a carbon exactly suited to the user's needs," says Mr. McBride. "There are infinite varieties of real or imagined needs among users; hence the manufacturer must know just how each change in raw material or in process technique affects the finished product in order that he may make each lot of the desired mechanical, chemical, and electrical characteristics.

"The principal starting materials in the manufacture of carbon products are crude coal tar from which pitch, tar-oils, and other products are made; petroleum oil, from which lamp black is prepared, and the several varieties of artificial and natural graphite, retort carbon, and petroleum coke, which enters into carbon mixes."

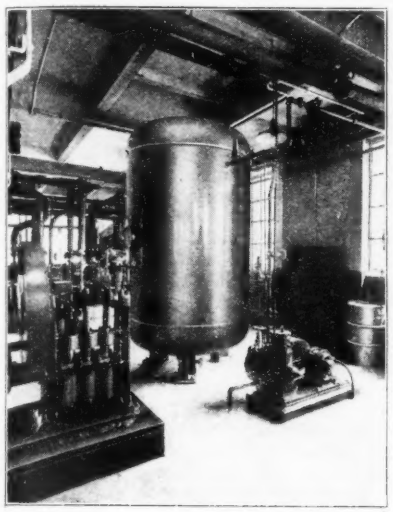


View of the main burner room, where carbon black is produced from the combustion of fuel oil. The oil pumps are visible in the foreground, and another battery of fuel-oil burners can be seen at the rear



In the pug mill at the right, the electrode ingredients are ground to a homogeneous mass, pressed into the desired form, and placed in the clay "sagger" with the proper amount of packing material, to be "baked"

Four principal groups of products are made at the Fostoria works: Extruded electrodes and other rod-like products of small diameter; projector and other carbons, both cored and solid; "therapeutic" carbons; and brush block. Some are extruded products, some are die-press formed, and some may be either extruded or die pressed. In each case the starting material is a carbon or mixture of carbons which has been appropriately tempered with tar or pitch before forming. The handling of



High-pressure water-supply tank and pumps which feed the presses

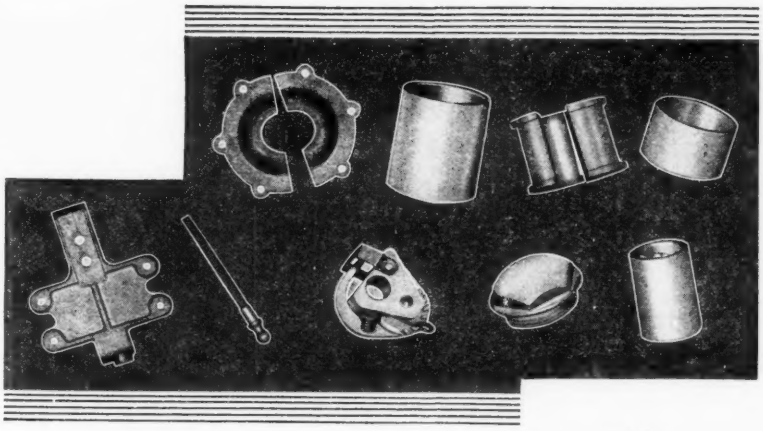
the various raw materials up to the stage of mixing for the various products is shown in the raw-material flow sheet of the plant.

Coke electrodes, as their name implies, are made with coke as the principal source of carbon; they are the lowest-grade, least-expensive form and are, of course, chosen whenever satisfactorily applicable to the purposes of the carbon user. In the manufacture of coke electrodes the process is essentially mixing of finely ground coke with pitch, blending at appropriate temperature, and extruding or pressing hot. The result is an electrode of approximately the desired size in the "green" condition; this is baked for elimination of the volatile content and then finished accurately to size and shape.

Projector and arc carbons are made by a succession of operations similar to those involved in electrode manufacture. The appropriate mixture of carbons in the form of carbon "flour" is blended in a steam-heated mixer with pitch or tar. The mixture is put through rolls in order to eliminate any lumps of unblended carbon and then sent while hot to the extruding presses. The extruding gives either a solid rod for the ordinary type of arc carbons, or a hollow rod for those special carbons in which the core material is to be inserted. The green rod stock is baked, the baked stock cleaned, cut to the desired lengths, and the core, if any, is inserted. This core material is a mixture of rare-earth fluorides or appropriate metallic oxide which must be rebaked at a low temperature in a batch furnace after being pressed into the hollow center of the carbon. The pointing, butt-end finishing, and electroplating completes the carbon. The cored carbons are given a special test in order to indicate imperfections in the core.

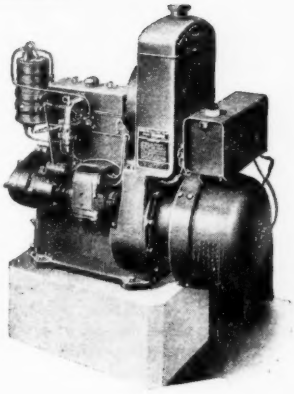
Reducing costs for...

KOHLER of KOHLER



THE Kohler Automatic Light Plant provides an outstanding example of the manufacturing economies which can be effected through the proper application of die castings.

In this particular assembly, ten Milwaukee Die Castings made of four different alloys are used. Undoubtedly some of these parts could be made of other materials and by other methods, but Kohler engineers were convinced that correctly designed die castings would serve the purpose more effectively at a much lower cost.



This non-technical booklet on the die-casting process will help you decide whether or not parts of your product can be die-cast to advantage.

The engineers were right! On four parts, alone, the use of die castings has eliminated nine machining operations, three patterns and five jigs, reducing the cost approximately 50%.

Perhaps a survey by Milwaukee Die Casting Technicians would uncover the possibility of similar savings in the manufacture of your product. Why not have one made without cost or obligation?

MILWAUKEE DIE CASTING COMPANY
287 FOURTH STREET MILWAUKEE, WIS.

MILWAUKEE
DIE CASTINGS AND BEARINGS

This is essential because if there be an imperfect core it interrupts proper functioning of the carbon and the arc will go out.

Although the operation is not conducted at this plant, this company produces carbon electrodes as large as 40 inches in diameter and 10 feet long.

Pyroxylin Shatter-Proof Glass

FIVE hundred automotive engineers, executives of safety councils, and journalists were asked to vote on which of seven improvements for motor cars made during the past year they considered most essential. Non-shatterable glass led the field; in fact, it received almost as many votes as the next three innovations together—automatic chassis lubrication, light control on steering wheels, and vibration dampeners.

Now what is non-shatterable glass? *The DuPont Magazine* tells us to think of a cheese sandwich. Instead of two pieces of bread, think of two panes of thin plate glass. Instead of a slice of cheese, think of a sheet of transparent Pyralin. Instead of butter think of a colorless liquid with adhesive properties. Make a sandwich of these materials and you have it—all expect the process of binding these components together. That is done by heat and hydraulic pressure.

The discovery that a sheet of pyroxylin plastic cemented firmly between two pieces of glass makes a non-shatterable product is by no means a new one. As a matter of fact the original patents taken out on this idea have expired. But the technique of producing really transparent material which would not discolor with age has called forth considerable chemical skill. In its maufacture only the purest ingredients are used, and the equipment has been modified so that the materials are kept in closed systems throughout the process. Cotton from certain sources only is used, and water of a prescribed mineral content. The acids are specially treated before nitration. Other ingredients such as color, stabilizers, plasticizers, and the like are very accurately controlled chemically. Filtered air is used at various stages, and only trained operators of the highest type are capable of handling the work.

Remarkable Metal Shell Reported

REPORTS of a new process for coating almost any substance with a uniform shell of metal of any desired thickness emanate from England, via *Chemical Age*. The process is described as a discovery whereby all kinds of materials of any shape or contour, both conductors and non-conductors of electricity, can be metalized by electrochemical action to any desired thickness.

It is alleged that by the new process wood, aluminum, duralumin, tile, brick, plaster, et cetera, can be metalized for use in the building and allied trades. The materials are rendered damp-proof and fire-proof with greatly increased strength. Metal work can be rendered non-corrosive, and wood mouldings can be treated with bronze, brass, et cetera, for use on shop front and decorative interior construction. Doors, window sashes, wainscotings, panel boards, and panelling can be artistically metalized with one metal on another. Materials such as cardboard or plywood can be given increased strength and resistance to the corrosive action of steam, heat, chemical fumes, and water. Linen, gauze, silk, leather, et cetera, can be delicately metallized with handsome results. Many airplanes and seaplane parts will, it is stated, be manufactured by this process, for great strength can be obtained and perfect resistance to water corrosion given. The cost of metalizing goods by this process is said to be extremely low.

Hydrogenating Brown Coal on a Commercial Plant Scale

OF almost as great interest as the German nitrogen fixation and fertilizer manufacture is the large experiment which the I. G. is making in the hydrogenation of coal at the Merseburg works, says *Chemical and Metallurgical Engineering*. Here the Bergius process, modified, it is reported, by the addition of a catalyst, is being operated on a large scale. The work was logically undertaken at Merseburg because the raw materials—coal and hydrogen — were available at lowest cost. Further, it was possible to draw up the extensive experience already gained in the technology of high-pressure, high-temperature processes.

It is understood that the hydrogenation process has not yet been developed to the profitable stage, but that the prospects are favorable for financial success this year. However that may be, coal is being processed at the rate of 1000 tons per day. It is finely incorporated with heavy oil to the consistency of putty, pumped into large containers and treated with hydrogen at high temperature and pressure. At the end of the contact period the mass is practically liquified. The liquid is filtered from the ash and unconverted residue and distilled. At present only one fraction is recovered, namely that suitable for motor fuel. The heavy oil remaining is incorporated with fresh coal and returned to the hydrogenation process.

Oil and Water Mix Too Well

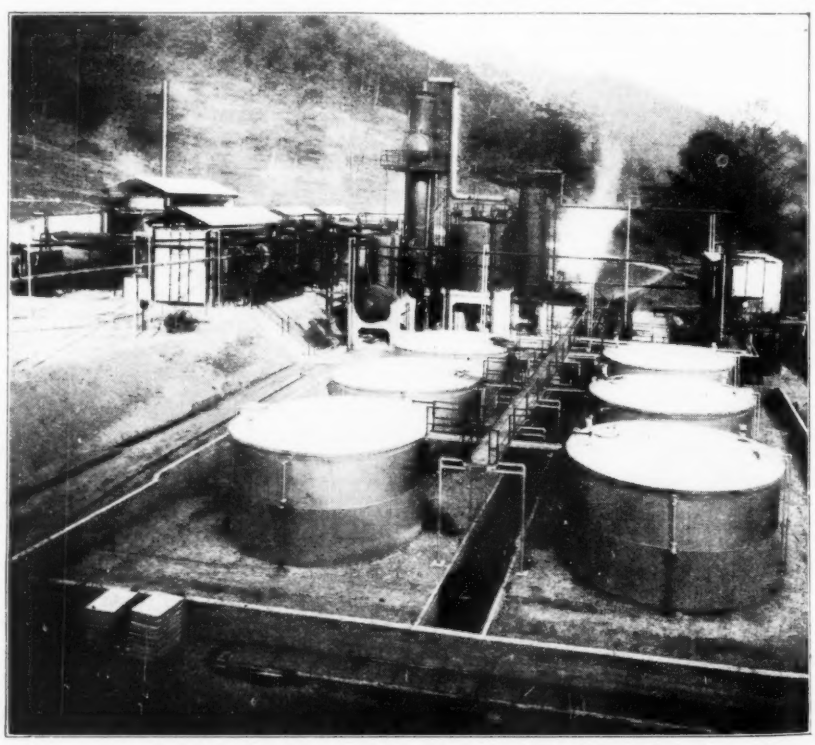
OIL and water will mix, said Dr. Gustav Egloff, Chicago chemist, before a recent meeting of the Institute of Chemistry. They mix so well that science has difficulty trying to separate them. Nature every year burdens the oil industry with over 2,000,000 barrels of intimately mixed oil and water as emulsified crude oil. Such oil does not separate its water even after years of storage.

There are at present over 100,000,000 barrels of emulsified crude oil in storage tanks and in sump-holes in the ground and the refiner is at his wits' ends as to how to separate the oil from the water. Thus over 100,000,000 dollars is tied up in stored emulsified oil, for whose utilization no really economical method has been evolved which is applicable to all situations.

There is no adequate background of theory to explain the involved nature of emulsified oils. Some have water in fine droplet form dispersed through the oil and making up 95 percent of the total. Wholly satisfactory explanations are lacking as to how they are formed or the process that takes place when they are broken into oil and water.

Many Uses for Soluble Silicates

MANY readers have an acquaintance with silicate of soda as "water glass" for egg preserving, but very few realize the great number of other uses to which the various soluble silicates can be put. James G. Vail, chemical director of the leading



View of an installation of the Gyro process at a West Virginia refinery in which gasoline is extracted from crude petroleum at the rate of 750 barrels per day. With public recognition of the anti-knock value of the product, "vapor phase" cracking of petroleum has recently received added attention

manufacturer of silicate of soda in the United States, gives detailed information about practically all the current chemical and industrial uses of the silicates in a fascinating book, just published, called "Soluble Silicates in Industry." The wide variety to be found in the chapters on different kinds of uses will be obvious from a simple mention of a number: dental grinding wheels, spark plugs, silicate cement, asbestos pipe covering, wallboard, adhesives, silk weighting, pottery glazes, ore floatation, laundering, cleaning aluminum, water softening, straw paper manufacture, and medical uses.

New German Disinfectants

ABOUT 95 plants in Germany now manufacture disinfectants for general and hospital use. The new process of distilling tar and tar products from coal at low temperatures offered the possibility of producing phenol products which possess good germicidal qualities. The Mathias Stinnes mine in Karnap has erected a plant which has been continuously manufacturing these products for over a year. They are known under the names of "ufinol" and "tusputol." "Ufinol" is used for general disinfection while "tusputol" is used for disinfecting the saliva of tubercular people and for the disinfection of clothing, et cetera. These two products formerly retained the odor of phenol; however, it is now reported that a process has been found to deodorize them and even to give them a pleasant odor, which has resulted in greater use by hospitals and sanitariums.

The further products gained through low-temperature carbonization are "stabinol" and "pethanol." "Stabinol" is used for the disinfection of animals and stables and has qualities similar to "ufinol." "Pethanol" is used for killing all kinds of plant insects. It is alleged by the producers that blood, tree, and wool lice are killed without the least damage to the leaves. The insecticide may be used in a 1 percent solution for spraying at all times of the year, an advantage, it is claimed, over other insecticides which usually contain at least a 20 percent solution and therefore hurt the leaves. Experiments are being made in the use of "pethanol" for soil disinfection and to combat blight on elm trees.

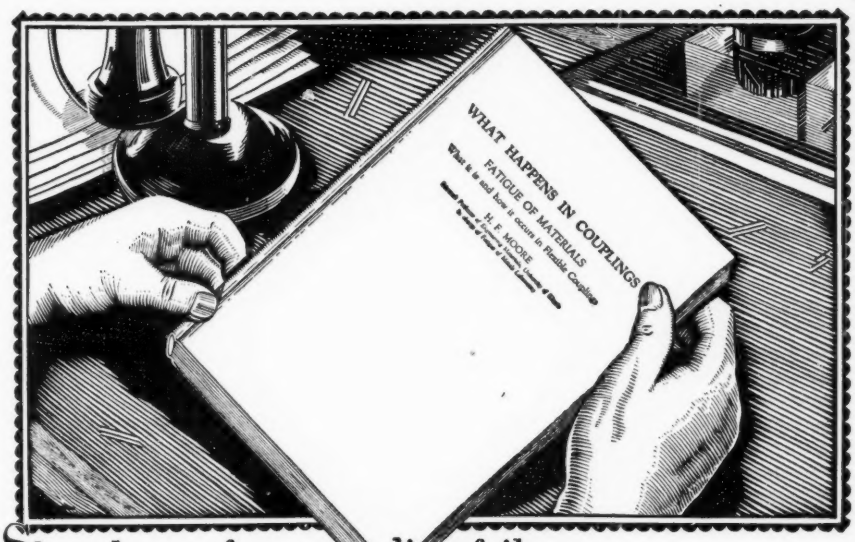
Toes As Weather Prophets

MANY people have attributed to their toes the power to foretell changes in the weather, little realizing that the pain was merely an indication that the leather in their shoes was shrinking. J. Arthur Wilson, the foremost leather chemist of America, who was recently awarded the Chandler Medal for his distinguished contributions to leather technology, explains the phenomenon as follows:

"In going from a dry to a moist atmosphere, chrome leathers increase in area by an average of about 18 percent. They shrink in area correspondingly when the relative humidity falls. Vegetable-tanned leather, on the other hand, undergoes changes in area only one third as great as this. For reasons that had nothing to do with the comfort and happiness of the ultimate consumer, it became desirable for the tanner and shoe manufacturer to have about 95 percent of all the sole leather vegetable tanned, and about 95 percent

(*Please turn to page* 373)

This Book costs you nothing and may save thousands in your plant!



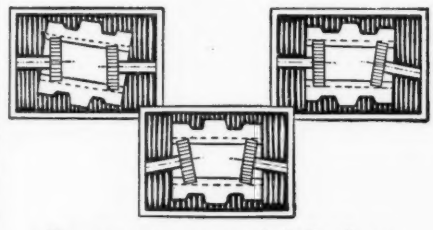
Shut-downs from coupling failure cost money and can be avoided

Since early days, old-type flexible couplings have depended on flexible materials (rubber, leather, fibre, spring-steel) to provide the "give" necessary to take up misalignment.

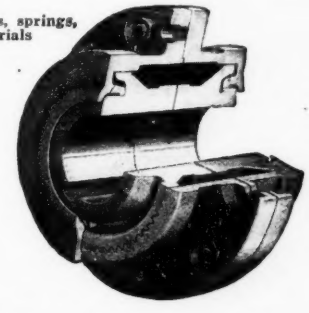
What makes this flexible material break down? Read this short book. It is by one of the outstanding authorities on Fatigue of Materials. See that the way to eliminate failure is to eliminate flexible materials—as done in Fast's Self-Aligning Coupling.

Learn why the Fast principle of mechanical flexibility entirely eliminates all chance of coupling failure, thus avoiding coupling shut-downs in your plant. See the interesting diagrams showing the evolution of coupling practice, and the way Fast met the problem.

The coupling without flexible bushings, pins, springs, discs, grids or any other flexible materials



Two spur gears, one on each shaft end, are completely and continuously meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve revolve noiselessly as one unit, allowing free angular and lateral movement.



USE THE COUPON

Get this authoritative book. It's free. Learn how and why Fast's Flexible Coupling banishes coupling failures forever.

FAST'S
—SELF-ALIGNING—
COUPLING

THE BARTLETT HAYWARD CO.
204 Scott Street - BALTIMORE, MD.

Please send me the Free Book by Prof. Moore

Company.....
Individual.....
Address.....
City..... *State*.....

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Municipal

THE MODEL MUNICIPAL TRAFFIC ORDINANCE, by C. W. Stark, is a significant paper dealing with the need for standard traffic laws. The model municipal traffic ordinance, if generally adopted, would reduce confusion and would cut down the number of accidents on public streets and highways. The plan is comprehensive, yet sufficiently elastic to meet the needs of all communities, whether large or small. *National Conference on Street and Highway Safety, U. S. Department of Commerce, Washington, D. C.—Gratis.*

DISPOSAL OF WASTE CRANK-CASE OILS, by J. B. Gordon, Sanitary Engineer of the District of Columbia, is the report on a recent survey showing how waste crank-case oil is disposed of in 46 important cities in the United States and abroad. The report presents certain well-planned recommendations, based upon the results of recent tests by the Bureau of Standards in which it has been proved that by a commercially practical process of re-refining, oils suitable for re-use in automobile motors can be recovered from waste crank-case oil. *J. B. Gordon, Sanitary Engineer, District of Columbia.—Four cents.*

THE PROBLEM OF AUTOMOBILE EXHAUST GAS IN STREETS AND REPAIR SHOPS OF LARGE CITIES, REPRINT 1217, from *Public Health Reports*, will be of interest to many of our readers. *U. S. Government Printing Office, Washington, D. C.—Five cents.*

Construction

THE LAMELLA ROOF is a well illustrated 30-page brochure describing the new trussless roof construction that is in increasing demand for large unobstructed floor areas with the roof supported by walls only. The booklet traces the origin of the design, and illustrates its methods and advantages. *National Lumber Manufacturers' Association, Transportation Building, Washington, D. C.—Gratis.*

SEASONING, HANDLING, AND CARE OF LUMBER, a 96-page report with 40 illustrations, is an account of the methods used in seasoning lumber and the changes which take place in the wood during the process. A bibliography is included. *U. S. Government Printing Office, Washington, D. C.—25 cents.*

AIRPLANE HANGAR CONSTRUCTION, revised edition, is a well illustrated 40-page booklet containing information to assist airport authorities, manufacturers, aviation companies, and others who are interested in airport and hangar construction. The new regulations of the Department of Commerce for rating airports has been added, with an analysis of modern requirements for constructing hangars of requisite size. *National Lumber Manufacturers Association, Transportation Building, Washington, D. C.—Gratis.*

GENERAL BUILDING CONSTRUCTION WITH SLAG CONCRETE, SYMPOSIUM NO. 12, is one of a series of illustrated bulletins pertaining to the characteristics and uses of blast-furnace slag. *National Slag Association, 937 Leader Building, Cleveland, Ohio.—Gratis.*

Metallurgy

A STUDY OF CENTRIFUGALLY CAST PIPE *vs.* SAND-CAST PIPE, by F. N. Menefee and A. E. White, is the report of an investigation undertaken at the request of the Water Board of the City of Detroit to determine the relative merits of sand-cast pipe and pipe centrifugally cast in metal molds. The report also includes some interesting discussion on the subject. *Department of Engineering Research, University of Michigan, Ann Arbor, Michigan.—Fifty cents.*

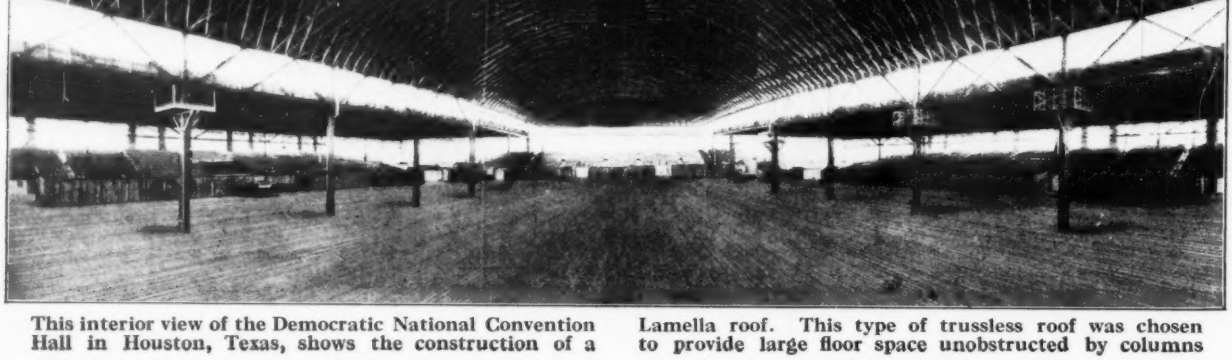
THE STABILITY OF METALS AT ELEVATED TEMPERATURES, and STAINLESS STEEL, A DIGEST WITH ABSTRACTS AND BIBLIOGRAPHY are two bulletins by Claude L. Clark and Albert E. White that will be helpful to those seeking reliable information on these subjects. *Department of Engineering Research, University of Michigan, Ann Arbor, Mich. "Stability of Metals,"—One Dollar. "Stainless Steel,"—50 cents.*

A STUDY OF CHROMIUM PLATING, by Richard Schneidewind, is a comprehensive study of chromium plating, based upon the results of a two year research program financed by the Detroit Edison Company. It is designed to help executives and engineers interested in chromium plating in a general way, and to aid electrochemists with a detailed account of the original research done at the University of Michigan during 1927 and 1928. Important information as to scientific and patent literature on the subject is included in the booklet, which has 141 pages and is illustrated. *Department of Engineering Research, University of Michigan, Ann Arbor, Mich.—One dollar.*

Petroleum

STUDIES IN FRACTIONAL DISTILLATION OF CRUDE PETROLEUM, BUREAU OF STANDARDS TECHNICAL PAPER NO. 431, will be of interest to all who are connected with the oil industry. The booklet contains 58 pages and 16 illustrations. *U. S. Government Printing Office, Washington, D. C.—15 cents.*

ELECTRIFICATION IN THE PETROLEUM INDUSTRY, CIRCULAR 1820, discusses the many practical and economical applications



This interior view of the Democratic National Convention Hall in Houston, Texas, shows the construction of a Lamella roof. This type of trussless roof was chosen to provide large floor space unobstructed by columns

of electricity in the various branches of the oil industry. *Westinghouse Electric and Manufacturing Company, 150 Broadway, New York City.—Gratis.*

NATURAL GASOLINE IN 1927, by G. R. Hopkins, is the most recent statistical compilation of the Bureau of Mines relating to the rapidly expanding natural gasoline industry. *U. S. Government Printing Office, Washington, D. C.—Five cents.*

Miscellaneous

METHODS OF DETERMINING THE HYDROGEN-ION CONCENTRATION IN SOILS, CIRCULAR 56-C, of the Department of Agriculture, describes the latest methods and equipment used in testing soils for pH values, to determine the degree of acidity or alkalinity of the soil. The significance of the pH value in agricultural soils is also explained. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

IMPORTED PARASITES OF THE EUROPEAN CORN BORER IN AMERICA, TECHNICAL BULLETIN 98, by D. W. Jones of the Bureau of Entomology, Department of Agriculture, is a valuable and interesting summary of the campaign being waged against the corn borer. Complete information as to the value and habits of the various imported parasites is presented in this 27-page bulletin. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

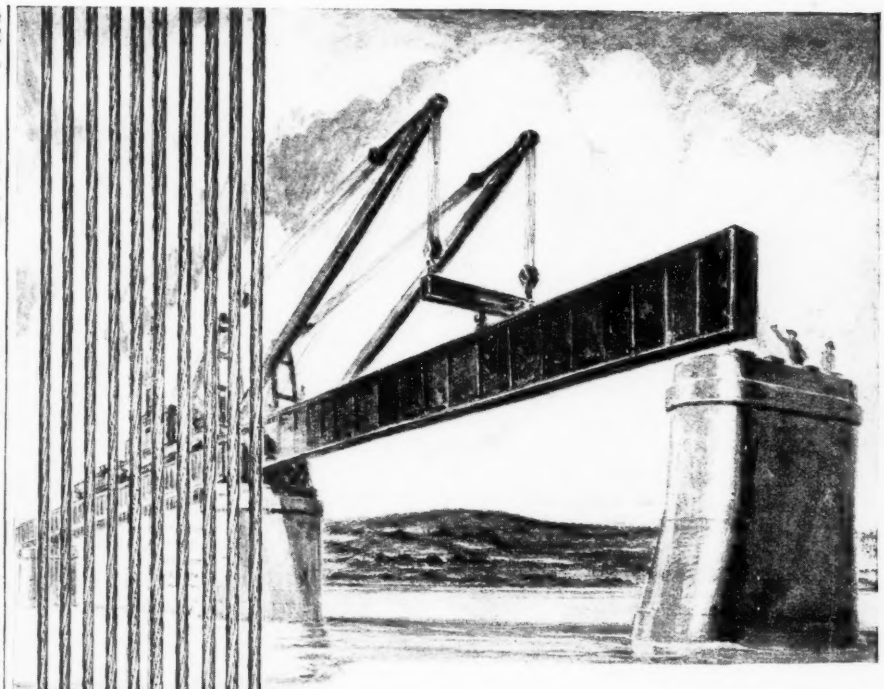
THE TRUTH ABOUT SNAKE STORIES, by Karl P. Schmidt, is an attempt to de-bunk our store of fanciful legends about the strange powers and behavior of various kinds of snakes. Similar leaflets of the Field Museum treat such subjects as "The American Alligator," and "The Wild Turkey." *Field Museum of Natural History, Chicago, Ill.—20 cents.*

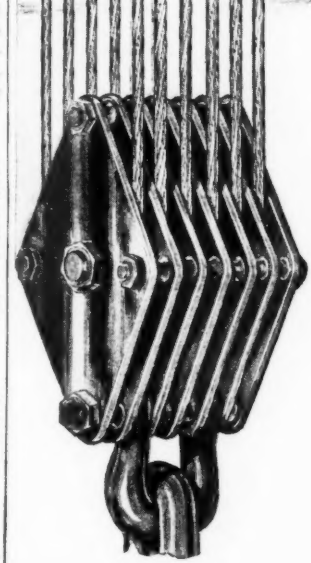
UNIDIRECTIONAL RADIO BEACON FOR AIRCRAFT, RESEARCH PAPER NO. 35, describes the new developments for guiding aircraft with directed radio beams. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

OPPORTUNITIES FOR ENGINEERS IN THE UNITED STATES CIVIL SERVICE includes a table showing salaries and distribution of government engineers. *U. S. Government Printing Office, Washington, D. C.—Gratis.*

METHODS OF TEST RELATING TO ELECTRICAL INSULATING MATERIALS, a 155-page pamphlet, is an outline of tests and specifications showing ways to determine the relative merits of various materials used for electrical insulation. *American Society for Testing Materials, 1315 Spruce Street, Philadelphia, Pennsylvania.—85 cents.*

PHYSICAL PROPERTIES OF DENTAL MATERIALS is a 28-page report on an investigation conducted by the Bureau of Standards regarding the important properties of gold alloys in the various forms used in dentistry. *Superintendent of Documents, United States Government Printing Office, Washington, D. C.—35 cents.*





Motorists

You need a Basline Autowline in your car for emergencies. Made of ¼-inch Yellow Strand wire rope with patented snap hooks for quick attaching. Very strong but small enough to coil flat under a cushion. Ask your accessory dealer.

Spanning Mighty Waters

It takes more than mere brute strength to handle safely the tremendous girders used in modern bridges. It takes stamina of the highest character—a reserve force that won't play out.

In Yellow Strand Wire Rope this highly desirable quality is obtained by using special wire, drawn in Europe to our own specifications. A *strand of yellow* distinguishes Yellow Strand from all other ropes.

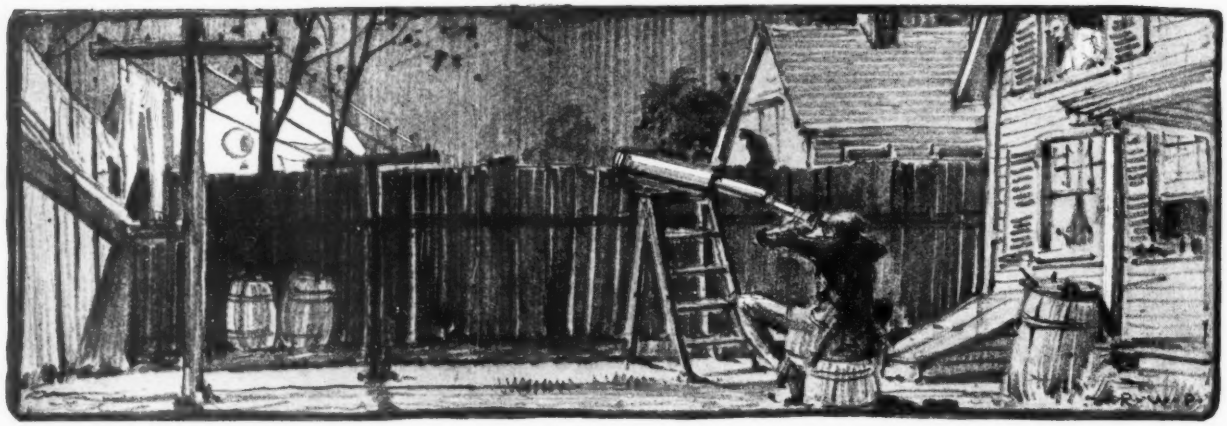
This company has been making wire rope exclusively for over half a century. The "know how" that produces Yellow Strand is also responsible for the conspicuously high quality of all our Standard grades.

"Yellow Strand" or "Broderick & Bascom," written into your next wire rope requisition, will show your good judgment.

BRODERICK & BASCOM ROPE CO.
843 North First Street, St. Louis, Mo.
Eastern Office and Warehouse: 68 Washington St., New York City
Western Office: Seattle Factories: St. Louis and Seattle
Authorized Dealers in all Industrial Localities

Yellow Strand WIRE ROPE

MR466



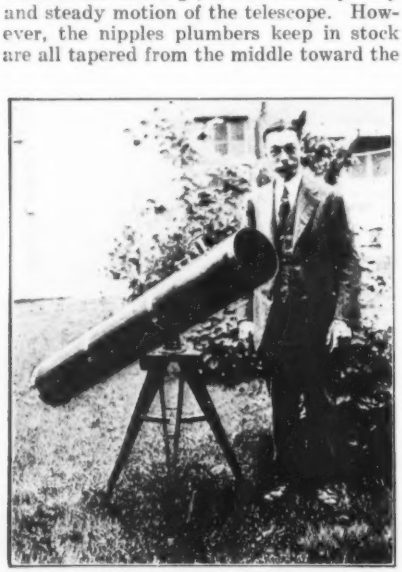
The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

"I ATTENDED the Telescope Makers Convention in Springfield, Vermont, in 1927, and became so much interested in the work, that since then I made two telescopes—a six-inch Newtonian, and later an eight-inch Herschelian," writes Dr. D. George Knecht, 35 North Ninth Street, Allentown, Pennsylvania.

"Living in a closely built up section in Allentown, with high buildings and bright lights all around me, which interfere so much with this work that it is very unsatisfactory, I made the telescopes portable so that I can take them out into the country or to some open space where I have a good view of the sky and can be away from the bright lights. For this reason I am using a tripod.

"The mounting of the Newtonian telescope is made of steam fittings. I used a 45 degree angle, a 90 degree angle, three close nipples and two floor flanges. When I assembled these I had an equatorial mounting; giving me motion in right ascension and in declination. Using the threads for bearings, I have a very easy and steady motion of the telescope. However, the nipples plumbers keep in stock are all tapered from the middle toward the ends. They are especially made this way to make steam-tight joints, but they do not work well in a telescope mounting, so I had straight nipples made by a machinist.



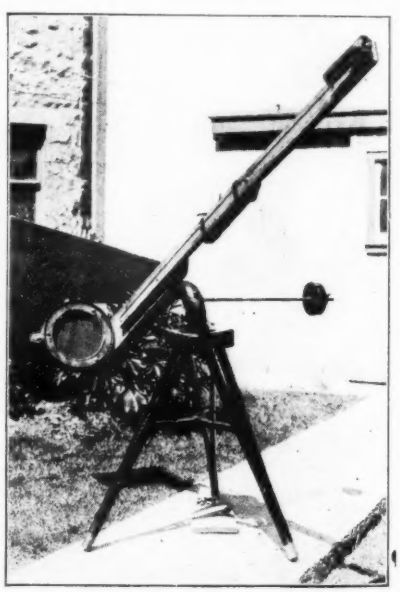
Dr. Knecht and six-inch Newtonian

"I live in latitude 40 degrees 43 minutes, so the 45 degree angle is just a little more than four degrees short of a polar axis. To correct this I tilt my tripod just a little toward the north and thus I get an approximate polar axis. If I were to put this mounting on a concrete post or a section of a water main, I would correct it by putting a wedge under the base flange, and tilting the mounting enough so that the 45 degree angle would point exactly to the pole of the heavens."

William J. Davis, 7736 Elmgrove Drive, Elmwood Park, Illinois, has discovered that an old swivel chair need not be retired to the attic or sent to the junk-heap. He writes: "After giving my telescope a six month trial, I believe it is time for me to tell the Telescope Editor about it. My mirror is a six-inch, ground and polished to a focal length of 45 inches. I made my own diagonal and two low-power eyepieces. The mount is from a discarded swivel chair, with the seat removed and the end of the legs cut off.

"I believe I have an exceptionally good parabolic mirror because of the good definition I sometimes get of the stars when using a quarter inch eyepiece. I don't see why anyone should stand up and bend over to polish a small size mirror. I used a table and sat down during the whole process."

G. C. Hanley of Mincha (no state, no country, mentioned) sends in a brief note about his telescope, with two photographs. He writes on the letterhead of the "Mincha Butter Factory—Pasture Gold Butter." No acknowledgement could be sent him because the address was incomplete. No Mincha is listed in the United States Postal Guide, and none appears in our gazeteer of the world. However, we located Mincha—at least we believe it is somewhere on earth, and presumably not far from one of the two 36th parallels of latitude. A protractor placed on the polar axis of the telescope in the illustration proves this. There is no clue, however, to the longitude, but one of the photographs (not reproduced) shows a tree that looks exotic. Our hunch is therefore—Australia. Down there a polar axis is still parallel to the earth's axis but it points south, not north (its lower end points north). The Sun daily crosses the northern, instead of the southern, heavens; but it still rises in the east. In short, everything is mixed up—which is probably just what an Australian amateur thinks about things up here "on top" instead of "down under," where he lives. Mr. Hanley writes:



Dr. Knecht's eight-inch Herschelian

"I am sending you some photos of the eight-inch telescope I made with the help of the article in the SCIENTIFIC AMERICAN. This is the second telescope I have made. The first was a four inch. It had a good mirror except for a turned-down edge. The eight-inch mirror had a raised zone, but after a few nights' work I got it figured correctly.

"The mounting is made almost entirely from pipe fittings and old Ford parts. Slow motion is obtained by having a lug on the

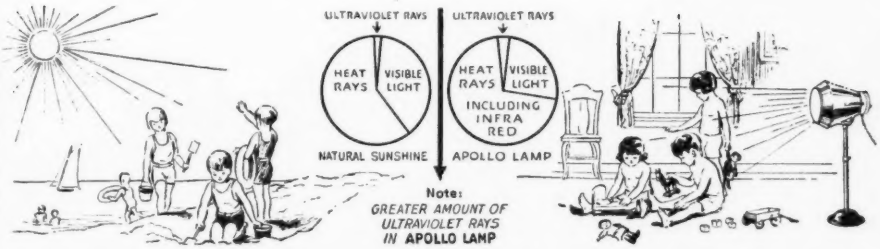
Mr. Davis and swivel-chair mounting

edge of the friction disk, coupled to a long-threaded bolt. This method gives good control. I have not yet fitted the slow-motion control to the declination axis. The telescope controls very well as it is."

Amateurs whose telescopes are completed will find plenty of serious work to perform with them. One possibility is contained in a paper entitled "Photographs of Venus" by Prof. Frank E. Ross of Mt. Wilson Observatory, published in Number 1, Volume 68, of the *Astrophysical Journal*. To quote: "In view of the success of Mr. A. Rordame in securing photographs of a marking of this nature in full daylight, a field offering results of value is opened to amateurs possessing only very modest equipment." In the work referred to, a nine-inch refractor had been used, and markings on Venus were photographed on commercial film. A 12-inch reflector should easily give comparable results; even a 10-inch might.

Someone has raised the question: Who first originated the common method of grinding and polishing specula—the equal sized disk and tool method, in contradistinction to the older small-tool method? The credit for this discovery evidently belongs to Dr. Elihu Thomson, now Director of the Thomson Research Laboratory of the General Electric Company, a Corre-

Mr. Hanley's eight-inch telescope

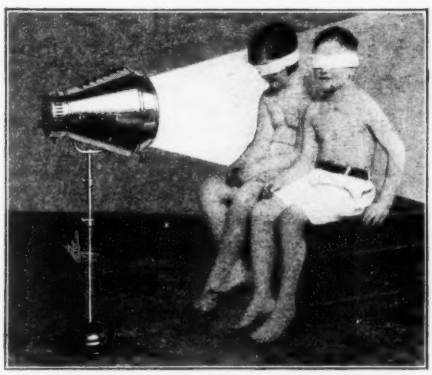


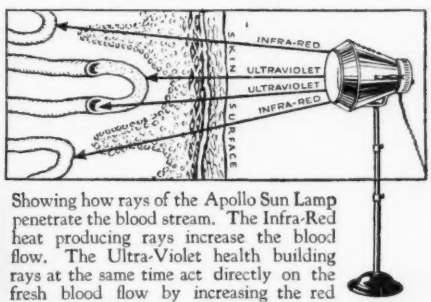
This is the Sun-Rival Whose Rays Penetrate the Blood Stream

By dilating the capillaries (minute blood vessels) the new Apollo Ultra-Violet Sun Lamp stimulates the flow of blood from the depths to the surface through the layers of muscular tissue. It regularizes the circulation and revives a sluggish muscular system. Its tonic action stimulates new life in the vital organs. It sharpens the appetite, aids digestion and normalizes the functions of the entire endocrine system.

Apollo Ultra-Violet Rays by entering the blood stream, charge the calcium in the blood with Ultra-Violet electrical energy, speeding up the process of metabolism and supplying vitamin D. The Calcium in the blood is more quickly transformed into body structure in the continuous process of cell building and rebuilding. The red corpuscles are multiplied—anemia is relieved and the leucocytes in the blood which fight off disease germs, are given new strength and vigor Remember it is not the heat, but the light that heals.

Sun-Starvation Prevents Perfect Health





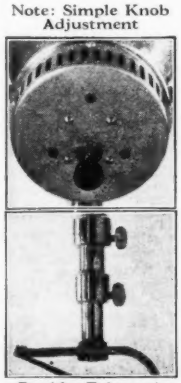
Showing how rays of the Apollo Sun Lamp penetrate the blood stream. The Infra-Red heat producing rays increase the blood flow. The Ultra-Violet health building rays at the same time act directly on the fresh blood flow by increasing the red corpuscles and charging the Calcium in the blood for quick transformation into body cell structure.

Develop Life's Greatest Asset

Profit now by the knowledge and experience of men like Dr. Rollier of Switzerland, Dr. Schuind and others whose scientific tests have shown these Ultra-Violet Rays to outweigh all health building ray treatments known to the category of light and electricity. Decide now that you too will join the happy folks who live and breathe in a body well nourished with nature's greatest gift.

You will be particularly pleased to learn that the design and construction simplicity of the new Apollo now brings this superior Ultra-Violet Sun Ray Lamp to you at an amazingly low cost. Let us tell you more about it.

Note: Simple Knob Adjustment



Double Telescopic Adjustment for Raising or Lowering

APOLLO
ULTRA-VIOLET
SUN LAMP

The Apollo Mfg. Co.,
10512 Western Ave.,
Cleveland, Ohio.

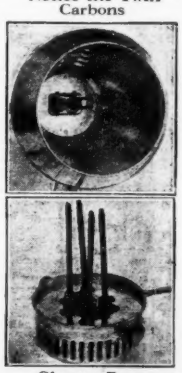
Please tell me how I can get the new Apollo Ultra-Violet Sun Ray Lamp.

Name.....

Address.....

City.....State.....

Notice the Twin Carbons



Observe Ease of Carbon Change

Einstein's New Theory

is partially based, as he himself states, on the work of the famous astronomer

Eddington

Though his work has been well known to science for many years, it now takes on popular interest.

Read what he has to say of modern physical concepts, in his thought-provoking work

The Nature of the Physical World

By **A. S. Eddington**
Prof. Astronomy, Cambridge

$3.90 postpaid domestic

SCIENTIFIC AMERICAN

Build America's Most Popular
Sport Plane for $199.00 10c for large Illustrated Folder
HEATH AIRPLANE COMPANY. 1727 Sedgwick St., Chicago, Ill.

Learn how the BOLENS saves time and energy in Garden Plowing, Seeding, Cultivating, Spraying Lawn Mowing and Hay Mowing. Important New Tools. Attachments instantly interchangeable. Many vital patented features. Arched Axle, Tool Control, One Hand Power Turn, Pulley for Belt Work. Easy payment plan. Write today.

BOLENS GARDEN TRACTOR

GILSON MANUFACTURING CO.
804 Park St., Port Washington, Wis.

30 Days' Free Trial New Models now ready for delivery direct from our factory. *Astonishing* low prices and terms. Do not buy until you get them. RIDER AGENTS WANTED to ride and exhibit sample. Make big money. Many models $21.50 up. **Tires** *Guaranteed $1.50* each, wheels, lamps, horns, equipment at *half usual prices*. Send No Money. Write for our marvelous prices and terms on RANGER Bicycles.

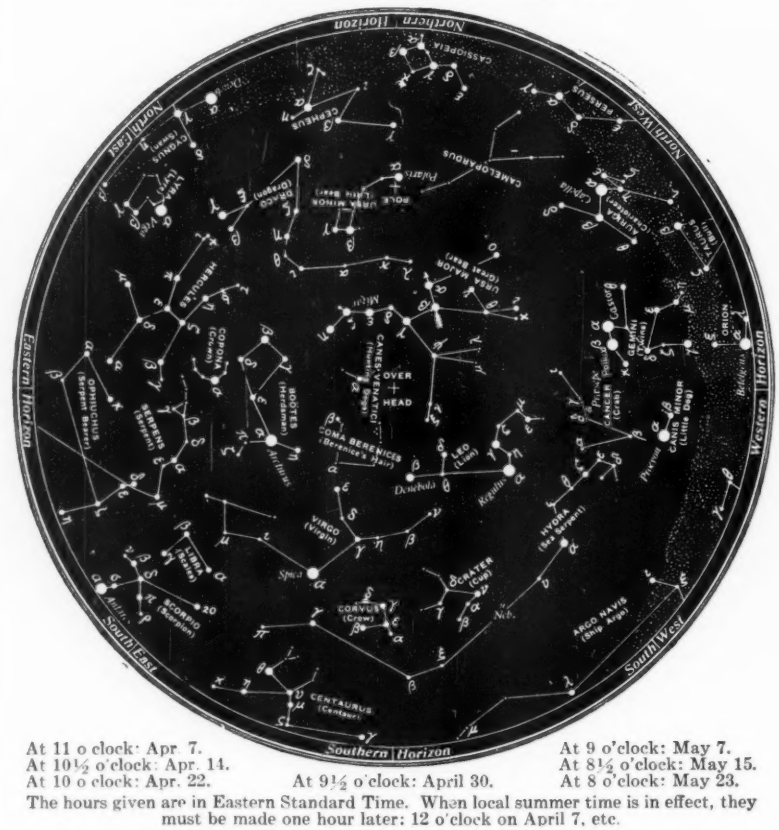
Mead CYCLE CO. Dept. D175, CHICAGO

sponding Editor of this journal. In 1878 Dr. Thomson described it in the *Journal of the Franklin Institute* as "A New Method of Grinding Glass Specula." The question was referred to Ellison, who also believes Thomson deserves the credit. He suspects Short, an early professional, had previously hit upon the same method, about 1750. If so, he kept it a secret, and therefore deserves no credit.

Finally, a bit of good news: our friend Russell W. Porter, by common consent the leader of all the American amateur telescope makers and co-author of "Amateur Telescope Making," has been honored by a call to California by those who are in charge of plans for the new 200-inch telescope. The project is co-operative between California Institute of Technology and Mount Wilson Observatory. Mr. Porter will take part in the design of the instrument and optical shops required in connection with the new Astrophysical Observatory, and will also co-operate on the design of the great 200-inch telescope and other instruments. He retains his connection with Vermont, but he has also been designated Associate in Optics and Instrument Design at the California Institute of Technology. All amateurs will wish him success and follow his progress with keen interest.—*A. G. I., Tel. Ed.*

The Heavens in April

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o clock: Apr. 22.
At 9½ o'clock: April 30.
At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 23.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

MERCURY is in conjunction with the Sun on the 17th. Although theoretically a morning star before that date and an evening star afterward, he is practically invisible.

Venus is an evening star when the month begins and sets a little after 8 P.M. She is rapidly overtaking the earth, and on the 20th she passes between us and the Sun and becomes a morning star. Owing to the inclination of her orbit she passes more than five degrees to the north of the Sun, so that a watchful observer in a good climate would find that only a few days elapsed between his last glimpse of her in the twilight and her reappearance in the dawn.

Mars is now past quadrature and an evening star, but very far north of the equator; he remains in sight for an hour after midnight.

Jupiter is an evening star setting at 9 P.M. on the first and about 7:30 on the 30th.

Saturn is in Sagittarius and rises at midnight in the middle of the month.

Uranus is in Aries, too close to the Sun to be seen; and Neptune is in Leo, observable all the evening.

The moon is in her last quarter at 2 A.M. on the 2nd; new at 4 P.M. on the 9th; in her first quarter at 9 A.M. on the 16th; and full at 5 P.M. on the 23rd. (These hours, as is always the case in this summary, are Eastern Standard Time—not "daylight saving.") She is nearest the earth on the 12th and farthest away on the 1st—and again on the 28th. During the month she passes Saturn on the 1st, Uranus on the 8th, Mercury on the 9th, Venus on the 10th, Jupiter on the 11th, Mars on the 15th, Neptune on the 18th, and Saturn a second time on the 28th.

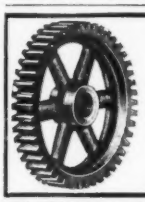
CHICAGO TECH
FOUNDED 1903
ENGINEERING-ELECTRICITY
ARCHITECTURE-DRAFTING

4 Fields of real opportunity. Big pay—a permanent position or a business of your own. 7 Billion dollars spent last year in one of these fields alone. Train here in Chicago, America's industrial center. 2-yr. diploma and 3-yr. B. S. Degree Courses. *Special 4 months' practical course* in Drafting. Other short courses. Earn while you learn. Enter any time. Day and evening classes. No time wasted. Free Employment Bureau. Low tuition—easy terms. Athletics. Successful graduates everywhere. Free 80-page "Blue Book." Address the President, **Dept. D-57, 118 E. 26th St., Chicago, Ill.**

Bond Standard STOCK GEARS for Immediate Delivery
Write for Catalog No. 54-S
617 ARCH ST. CHARLES Bond COMPANY PHILA., PA.

WANTED MEN
To Manufacture Metal Toys and Novelties

Big demand for 5 and 10c store Novelties, Ashtrays, Toy Soldiers, Animals, Auto Radiator Ornaments, etc. We cooperate in selling goods you make; also buy these from you. Small investment needed to start and we help you build up. We furnish COMPLETE OUTFITS and start you in well-paying business. Absolutely NO EXPERIENCE and no special place needed. A chance of a life-time for man with small capital. Write AT ONCE if you mean strictly business and want to handle wholesale orders now being placed
METAL CAST PRODUCTS CO., Dept. S, 1696 Boston Road, New York City



GEARS
All Kinds—Small
The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.
Write for Catalogue 20
CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

BECOME A FOOT CORRECTIONIST
$3,000 to $10,000 yearly in a business of your own—many are making it in the New Profession of foot correction, not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.
STEPHENSON LABORATORY
23 Back Bay Boston, Mass.

IMPORT YOUR OWN GOODS
Big German Export Magazine published in ENGLISH; offers thousands of bargains in latest novelties; Opportunities for obtaining Profitable Distributing Agencies. Sample copy 60 cents.
SQUARE DEAL SUPPLY CO., F-246 Fifth Ave., New York

The Waco Wonder Shop

Make Things at Home
A set of Red Jacket Electric tools brings a powerful Master Drill Motor, Waco Craftsman's wood turning lathe, compound and 18-inch rests, tilting saw table, scroll, jig and bandsaws, and all accessories for drilling, buffing, grinding and cleaning. Attaches to light socket and gives you private machine shop. *ONLY $10.00 DOWN.*
Free Crafts Course and Blueprint Service
Send Coupon for Interesting Literature. You will be surprised, Instructive, Fascinating, Beautiful.
WACO TOOL WORKS, Inc.
5216 W. Kinzie St., Chicago. Dept. K4.
Please send me all information FREE.
Name.....
Address.....

Industries From Atoms

(*Continued from page* 367)

of all the shoe-upper leather chrome-tanned. When this was brought about, no one suspected the differences of shrinkage and expansion of the two kinds of leather. The shoe upper is thinner and tends to reach equilibrium with the air much more quickly than the very thick sole, and so the changing size is much more effective when the upper is chrome-tanned.

"Nearly everybody wears shoes with chrome-tanned uppers, which are subject to these great size changes with changing atmospheric conditions. For this reason most people suffer unnecessary discomfort. The tanner will use any method of tanning which the consumer demands, but like most people, is slow to make a change until the demand is urgent. The interesting scientific fact is that the kind of tannage so greatly influences the power of leather to take up water and change in size."

"Dope" Makes Money Last Longer

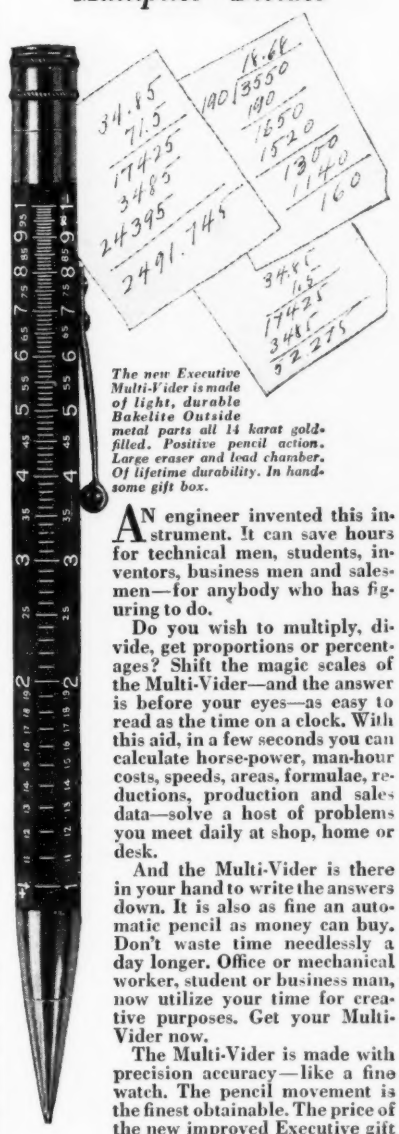
MOST of us are interested in making money go as far as possible, and government chemists are constantly at work to achieve the same end. Through the use of paper having increased fiber strength, the proportion of the United States paper money that is redeemed because of its being broken or torn has been reduced until it is almost negligible. Most of the paper currency that is now withdrawn from circulation on account of being considered unserviceable is declared unfit because of oil or grease stains, dirt, creasing, and other evidences of surface wear.

At present, sheets of notes are resized with animal glue, but the demands of large-scale production have prevented the employment of the low-temperature drying methods that are essential for preserving in full the improvements contributed by the glue. The addition of tanning materials, such as formaldehyde, and of softening agents, such as glycerine, to the freshly sized paper has been studied, and the use of such reagents seems to offer considerable promise of improving the resistance of the resized notes to surface wear.

Various lacquers and varnishes have also been included in the investigation. Both cellulose nitrate and cellulose acetate lacquers or "dopes" have been tested. The work with varnishes has been limited in scope, but the materials used tended to make the paper surfaces somewhat sticky when warm and to increase the brittleness of the treated notes. Several nitrocellulose lacquers were tried, but these were generally considered to be impractical for large-scale application because of the strong and persistent odors of the solvents, which were of the type of amyl or butyl acetate, fusel oil, or similar materials. Objection was also raised to the excessively glossy surfaces imparted to the bills by the nitrocellulose lacquers used in the small-scale work.

With the co-operation of manufacturers of the materials, the possibility of using cellulose acetate as the protective material has been studied quite extensively. Many combinations of different cellulose acetates, plasticizers, and solvents were tested until there was developed a solution capable of imparting to printed surfaces improved resistance to oil, water, and wet rubbing, without noticeably decreasing the high

Do your figuring scientifically with the
RUXTON MULTI-VIDER
Multiplies—Divides



The new Executive Multi-Vider is made of light, durable Bakelite Outside metal parts all 14 karat gold-filled. Positive pencil action. Large eraser and lead chamber. Of lifetime durability. In handsome gift box.

AN engineer invented this instrument. It can save hours for technical men, students, inventors, business men and salesmen—for anybody who has figuring to do.

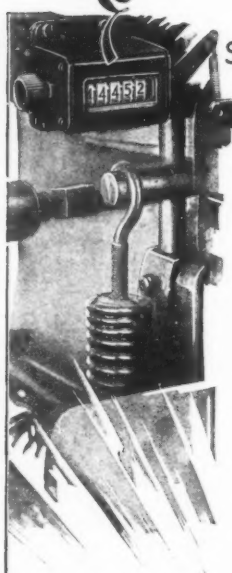
Do you wish to multiply, divide, get proportions or percentages? Shift the magic scales of the Multi-Vider—and the answer is before your eyes—as easy to read as the time on a clock. With this aid, in a few seconds you can calculate horse-power, man-hour costs, speeds, areas, formulae, reductions, production and sales data—solve a host of problems you meet daily at shop, home or desk.

And the Multi-Vider is there in your hand to write the answers down. It is also as fine an automatic pencil as money can buy. Don't waste time needlessly a day longer. Office or mechanical worker, student or business man, now utilize your time for creative purposes. Get your Multi-Vider now.

The Multi-Vider is made with precision accuracy—like a fine watch. The pencil movement is the finest obtainable. The price of the new improved Executive gift model with gold-filled cap, point and clip is $10.00—no more than you might pay for a high-grade automatic pencil alone. The serviceable Junior model, with outside metal parts in heavy silver plate, is $5.00. If your dealer doesn't have it yet, just mail the convenient coupon below.

Introductory Offer
RUXTON MULTI-VIDER CORPORATION,
Dept. P1, 2452 Graybar Bldg., New York City
Send me Multi-Vider Pencil with New Instruction Booklet. I enclose $10.00 for each Executive Multi-Vider ordered. ($5.00 for Junior model.)
Name.....
Address.....
Dealer's Name.....

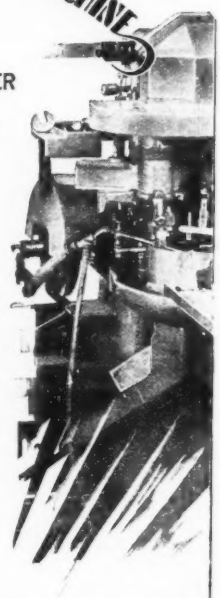
COUNTING PRODUCTION ON TAPPING MACHINES
WITH A
Veeder-Root
SMALL RE-SET RATCHET COUNTER



This machine turns out one to two thousand tapped pieces per hour. *Not a one* escapes reckoning on the dial of the Counter.

There is the record—always in front of the operator, urging *speed!* Let the work slow down, and the fact goes down on the Counter. It's a warning to the operator to *get busy.*

What a spur to production—at *any* machine! Either in operating or *developing* machines, you can set up records to aim at—and beat!



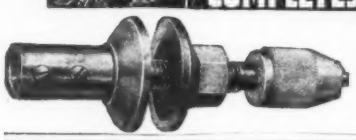
Anderson Dial Feed Tapping Machine, recording its output automatically. When the work's *done*, it's *counted.* Price of Re-Set Ratchet Counter illustrated, $6.00 (list).

Write for Veeder-Root bulletins showing *Counters for any machines you may need them on.* All are eligible!

You can equip your *other* production machinery to make high records automatically. Write for booklet showing Counters for *all* product-recording purposes.

Veeder-Root INCORPORATED HARTFORD, CONN.

COMPLETES YOUR MACHINE SHOP



$1.75 Without Chuck
$2.25 With Chuck

THE NEW IMPROVED EVRY-USE ELECTRIC MOTOR ATTACHMENT
Fastens directly on motor shaft, no pulleys or belts necessary. Holds grindstones, buffs, saws, wire scratch brushes, drills, etc. Serves as pulley. Made to fit ⅜, ½, and ⅝ inch shafts. State size. Postage prepaid if remittance accompanies order.
UNITED ELECTRIC MOTOR CO.
178 Centre St., Dept. E-4, New York

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS
Associated since 1846 with the Scientific American

SCIENTIFIC AMERICAN BLDG.
24-26 West 40th St., N. Y. C.

SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

TOWER BUILDING
Chicago, Ill.

HOBART BUILDING
San Francisco, Cal.

VAN NUYS BUILDING
Los Angeles, Cal.

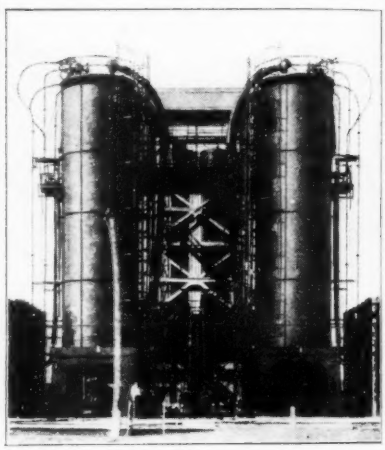
Books and Information on Patents and Trade-Marks by Request.
Associates in All Foreign Countries.

folding strength of the paper. The cellulose acetate forms a closely attached, invisible film that is free from gloss or stickiness and that does not bloom or discolor when dried at room temperature. Practical use of such a material would require special equipment for its application and for the removal of the organic solvents employed.

Soft Coal Smoke Costs Millions

"IT'S an ill wind that blows nobody good," and that goes even if the wind is laden with soot, for it means more business for the laundries. The pollution of the air by smoke from soft coal fires constitutes a serious evil, the magnitude of which is shown by data recently presented covering the situation in the city of Chicago and published in *Gas Age-Record.*

Considering fuel waste, extra washing and wear and tear of clothing, damage to



Two units of a Dubbs process plant in an Oklahoma petroleum refinery, where gasoline is produced by the "liquid phase" process of "cracking" oils for higher yields

textiles such as curtains and carpets, increased mortality and impairment of health, the annual loss in this city alone is estimated to be some 20,000,000 dollars. Taking the laundry item alone the average cost per person per year in Chicago is $3.25 as compared with two dollars in Philadelphia—or 50 percent higher.

Carbon Dioxide Fire Extinguishers

ONE of the latest fire-fighting methods to be introduced depends upon the blanketing, stifling effect of carbon dioxide for extinguishing the flames. One of the large manufacturers of fire-fighting equipment is now offering a carbon dioxide fire fighting system known as Alfite, which employs liquid carbon dioxide in metal cylinders under a pressure of 900 to 1000 pounds. When the system is placed in operation, automatically, semi-automatically, or manually as the case may be, a plunger ruptures a copper disk which seals the cylinder and permits the gas to pass through piping to nozzles directed toward the fire.

The Alfite system is designed to provide 35 percent dilution of the air in the space being protected. It is said, however, that 17 percent dilution is sufficient to extinguish flames. It is further claimed that the fire is under control within 30 seconds after

UNIQUE
TRADE MARK REG'D
THIN LEAD
COLORED PENCILS

Perfect for checking, figuring, sketching, marking blueprints, etc. Leads as thin as in No. 2 black pencils — easily sharpens to a needle point.

At all dealers or write direct

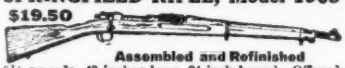
20 COLORS
all primary colors and shades
12 colors (Asst. No. 1116) per box $1.00
24 pencils (Asst. No. 1117) per box $2.00

$1.00 per dozen

AMERICAN PENCIL CO.
542 Willow Ave., Hoboken, N. J.

ACCOUNTING LESSON FREE
Don't *wonder* about Accounting Courses
Find out about this one by trying it free
Send for our 84-page book "How to Learn Accounting" and the first lesson free of charge.
INTERNATIONAL ACCOUNTANTS SOCIETY, INC.
A Division of the
ALEXANDER HAMILTON INSTITUTE
Dept. 32, 3411 So. Michigan Ave., Chicago

SPRINGFIELD RIFLE, Model 1903
$19.50



Assembled and Refinished
8¾ pounds, 43 inches long, 24 inch barrel. Offered without bayonet, $19.50. Packing charge 50c extra. Ball cartridges $3.50 per 100. New catalog, illustrated, 380 pages of Army-Navy equipment, pistols, guns, uniforms, saddles, for 50 cents.
Special new circular for 2c stamp. *Established 1865.*
Francis Bannerman Sons, 501 B'way, N. Y. City

ASTRONOMY PHYSICS CHEMISTRY
SCIENCE NEWS-LETTER
BIOLOGY ANCIENT LIFE PSYCHOLOGY

THIS is a most distinctive weekly. It rushes to the reader within fourteen days ***all important news*** in every branch of science. The same information does not reach the reader through other magazines for weeks and months.

All news contained is selected for its uniqueness plus genuine value. The result is ***a charming magazine*** filled with rare, refreshing bits. Often the information covers scientific changes affecting business and is exceedingly valuable.

Science News-Letter is issued to no one but individuals and libraries.

Introductory Offer, $1 for 13 weeks

MEDICINE HEALTH HEREDITY
2195 B St. Washington, D. C.
ENGINEERING RADIO AVIATION

the gas is released. The manufacturers state that fires in alcohol, ether, acetone, creosote, and lacquers are all effectively combatted by this means.

Soap Dust Explosions Form New Industrial Hazard

SOAP is not generally considered dangerous to handle but tests made by the Pittsburgh Experimental Station of the United States Bureau of Mines, Department of Commerce have shown that certain types of soap-dusts, when suspended in air, are more violently explosible than most dusts encountered in industry. The well known "cooling" effect of sodium compounds on the flames of explosives and the "semi-inorganic" nature of the compound, soap, might lead one to expect soap-dust suspensions to be relatively non-explosible. Soap-dust suspensions in air are, however, easily ignited and produce violent explosions accompanied by much flame and large quantities of heat.

Light Alloys Perfected

LIGHT alloys and combinations such as aluminum-coated steel are coming into increasing prominence as the metallurgists seek to keep pace with the development of aviation and the demands of industry for lighter, stronger, corrosion resistant materials. "Silumin," for example, is a new aluminum alloy containing about 13 percent of silicon and valued for its light weight, high tenacity, and workability when heated. The metal Elektron, produced in Germany, has also proved its worth in place of high-grade steels for automotive purposes; it is a very workable and light magnesium alloy.

The aluminum alloys are now joined by the new Alautal which consists of a light steel with a thin coating of pure aluminum applied to it. Possessing great strength, a low specific gravity (2.75), and high chemical resistance, it is said to retain its aluminum coating firmly, however thinly applied.

Gasoline from Natural Gas

NINETY-TWO percent of all natural gas utilized last year was treated for the recovery of natural-gas gasoline, which consititutes the most valuable by-product of the gas industry, according to a recent article in the *Magazine of Wall Street*.

A large proportion of natural gas leaves the wells in a "wet" state, that is, it contains varying percentages of volatile gasoline vapors which can be "stripped" from it by absorption and condensation, leaving the gas in suitable condition for pipe line transmission and providing, in the "natural" gasoline, a valuable motor fuel. The high combustibility of this gasoline makes it particularly applicable to airplane motors with but slight modification, and by blending with lower grade gasoline derived from petroleum, a highly satisfactory motor fuel is produced.

From 350 to 1000 gallons are recovered per million feet of gas treated, or, in other words, from the 1206 billion cubic feet of natural gas treated in 1927, there were recovered 1363 million gallons of gasoline, At an average value of ten cents a gallon, this brought in a revenue of 136 million dollars, nearly half as much as the total revenue derived from the sale of natural gas itself in the same period.

What's all the shouting about?

IT WAS a simple enough hunch—that a lot of pipe lovers secretly craved a milder mixture than they'd been smoking. We gave it to them—literally—a free tin to every man who asked for it. And now so many tobacco connoisseurs are cheering for Sir Walter that we can scarcely make enough of it. Isn't it time you too discovered how good a pipe can be?

LIMITED OFFER
(for the United States only)
If your favorite tobacconist does not carry Sir Walter Raleigh, send us his name and address. In return for this courtesy, we'll be delighted to send *you* without charge a full-size tin of this *milder* pipe mixture.
Dept. 193, Brown and Williamson Tobacco Corporation
Louisville, Kentucky

B.W. PRODUCT

SIR WALTER RALEIGH
Who discovered how good a pipe can be
It's milder

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMER. BLDG. 24-26 West 40th St., N. Y. C.
SCIENTIFIC AMER. BLDG. - Washington, D. C.
TOWER BUILDING - - - Chicago, Ill.
HOBART BUILDING - - San Francisco, Cal.
VAN NUYS BUILDING - Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request

Associates in All Foreign Countries

INVENTORS MODELS
Mechanical Specialists for over 20 years. Rendering Complete Service to the man with an Idea.
Labor Saving Machinery Designed & Built
Circular - References - Guarantee - Free
BERNARD & HELIER - 31 East 17th St. N.Y.C.

I SELL PATENTS
If you wish to add New Products to your line, or have a good Patent to sell, write me—
CHARLES A. SCOTT
Established 1900
773 SA Garson Ave. Rochester, N. Y.

We are equipped to develop inventions and also do manufacturing
MODELS MADE
Tools and Special Machinery
ATLAS INDICATOR WORKS
160 N. Wells Street CHICAGO, ILL.

CRESCENT TOOL COMPANY
Inventors--We Build Models
Send us your rough idea. Our Master Mechanics will develop it for you into a practical working Model. Thirty years successful experience doing this very thing. Best shop equipment. Expert advice. Confidential service guaranteed. Bank reference furnished. Send for free booklet "The Road To Success."
CRESCENT TOOL CO., Dept. C. Cincinnati, Ohio

Experimental and Model Work
Fine Instruments and Fine Machinery
Inventions Developed
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City

WORK ABROAD
WANT TO TRAVEL? Romantic . . . wealthy Southern countries need you. Want to go? Exceptional opportunities for young folks in Central and S. America, West Indies, Australia, etc. American employers pay fare and expenses. Get list, and "How to apply for position." Write today.
TROPICAL SERVICE BUREAU
14606-EA Alma Avenue Detroit, Mich.

HAVE YOU AN ELECTRICAL PROBLEM?
THE A. H. S. ELEC. SERV. & ENG. BUREAU, SPECIALIZING
In Personal Service, will solve them for you with Precision.
P. O. No. 132, FLUSHING, NEW YORK

FOR SALE
Canadian Patent No. 281,376
INFRA-RED THERAPEUTIC UNIT
A Unique Process of absorbing the irritative and the non-diathermic rays; generating and emitting pure Infra-Red Diathermic radiant energy of definite control wave lengths in great volume. Address J. T. Basseches, Esq., 342 Madison Ave., N. Y., or B. B. Fortney, 121 West Barbee Street, Louisville, Ky.

The Scientific American Digest

(*Continued from page 354*)

be now recognized as a standard method of writing, according to A. Tanakadate, member of the Imperial Academy of Japan, and member of the International Committee on Intellectual Co-operation. Important official documents, over 100,000 school books, and all the text books in technical schools and colleges are now using this type of letter.

Typewriters with key-boards arranged for writing Japanese with these characters are on sale and about 200 are now in use.

Professor Daniel Jones, eminent English linguist and phonetician, gives a full approbation to the Romanized Japanese system. The true function of Roman characters is to represent what Professor Jones calls diaphonemes; that is, certain groups of sounds peculiar to any particular language, and not the absolute individual sounds for which the international phonetic signs serve with sufficient approximation. —*Science Service.*

Photographic Reflections With Any Camera

THE average camera enthusiast is always looking for something new in the way of trick attachments for producing odd and unusual effects with his camera. We illustrate in these columns a novel reflecting attachment which may be used

What appears to be a lake before the Capitol is simply a photographic reflection made by a new device to be attached to a camera

with any camera, and we also present an example of the work accomplished with the attachment.

Within the cone-shaped device shown, is a glass plate with a reflecting surface. This bisects the cone horizontally and the two lower half of the mouth of the cone is covered. When a photograph is taken with this attachment in place, the upper half of the plate records the scene in the usual manner, whereas the lower half records a reflection which makes it appear that there is a body of water directly in front of the object photographed. By raising or lowering the camera, the extent of the apparent body of water may be varied.

This novel device was invented and

PSYCHIC BASE BALL
A Battle of Wits
$1.00
Complete with Rules Score Cards & Playing Field
PSYCHIC BASE BALL A GAME OF SKILL
A Game of Skill Crowded with Action
Mail Order Direct
If Your Dealer Cannot Supply You
PSYCHIC BASEBALL CORP.
Dept. S.A. 389 FIFTH AVE., N.Y.C.

"WONDER" Cold Pipe and Tubing Benders Do Not Crack, Flatten or Crimp the Pipe
Standard of the World
Hand and Motor Operated
14 Sizes of Machines
What it costs to bend pipe our way, per bend:
1-inch pipe . . . . . 5 cts
2-inch pipe . . . . . 10 cts
4-inch pipe . . . . . 25 cts
6-inch pipe . . . . . 60 cts
8-inch pipe $1.00
Send for Catalogue
American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.

PHOTO FINISHING
Send films and learn how the Famous WELLS FREE CRITICISMS and High Grade Service help you make
BETTER SNAPSHOTS
Beautiful, Permanent. Ask about free Art Enlargements. Films dev. 10c a roll. Prints 2¼x3¼ 4c; 3¼x4¼ 5c; 3A 6c. Postage paid both ways. Coloring, copies, miniatures, etc. Estab. 1910.
THE WELLS PORTRAIT STUDIOS, 12902 Euclid, Cleveland, O.

SAVE YOUR DESKS
No upkeep. Improves office appearance. Leading concerns use them. Try one on your desk for 10 days at our expense.
FREE Send desk size for TRIAL price details and Free Trial Offer.
IDEAL LINOLEUM TOP CO.
Dept. 12D 109 W. Austin Av., Chicago
To PROTECT NEW DESKS or RENEW OLD DESKS cover with the FINEST WRITING SURFACE at half the cost of glass or refinishing! IDEAL Desk Tops of green superfine cork composition are washable, scratchproof, free from eye-glare. Last a lifetime. Lieflat. Non-Slip back dispenses with fastening.
NEW or OLD

Keller Toy Double Wind-Mill
With Statue Arms moving in live-like manner. Photo free. Price $15.00. JOHN F. KELLER, Ottoville, Ohio.

FOR SALE
The New Mechanical Resilient Wheel for all vehicles. Manufacturing rights, etc., etc., for this country for disposal. Demonstrations arranged. Address Hill, Standard Bank of South Africa, Clements Lane, London, E. C. 4. England.

WHY NOT spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth $1 to $7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10 cents (not stamps) for my illustrated Prospectus before sending butterflies.
MR. SINCLAIR, DEALER IN INSECTS
Dept. 36, Box 1424, San Diego, Cal.
$2 FEMALE $1 MALE

AGENTS 500% PROFIT
GUARANTEED GOLD LEAF LETTERS
For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.
METALLIC LETTER CO. 440 N. Clark, Chicago

KINKADE GARDEN TRACTOR
AND POWER LAWN MOWER
A Practical, Proven Power Cultivator for Gardeners, Suburbanites, Truckers, Florists, Nurserymen, Fruit Growers.
AMERICAN FARM MACHINE CO.
1057—33rd Ave. S. E., Minneapolis, Minn.
Catalog Free

ALFALFA-SEED'S
Hardy Common Varieties, $8.40, $10.20 and $12.60 Bushel, Grimm Variety Alfalfa $18.00, Scarified Sweet Clover $3.90 and $5.20; Alsike or Red Clovers $15.00 Bags Free Send for Samples and Catalogue.
KANSAS SEED CO. SALINA, KANSAS

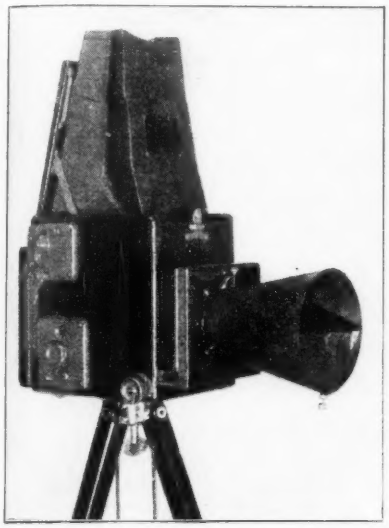
Why PURE CHEMICALS CORRECT ALL FEED WATER TROUBLE!
They prevent precipitation, control concentration, stop and prevent corrosion and pitting, remove oil or grease (carbonized or not), act uniformly under all temperatures and pressures, everything that is required to successfully treat boiler feed water. Only Pure *Corrective Chemicals* do this. *Pamphlet on Request*
UNISOL MANUFACTURING CO.
Jersey City, N. J., U. S. A.
Orders for UNISOL may also be purchased through HENRY W. PEABODY & CO., Export & Import Merchants, 17 State Street, New York City, N. Y., and their branch offices in Boston, San Francisco, London, Liverpool, Manila, Shanghai, Sydney, Melbourne, Auckland, Cape Town, Johannesburg, Durban, Buenos Aires.
Sime, Darby & Co., Limited, Singapore, S. S. Agents for Straits Settlements

patented by Jack Sussman, a New York news photographer on the staff of Herbert Photos, Inc.

"Movie" Actors Skate on Hypo "Ice"

ICE-SKATING in the "movie" dramas isn't done on ice at all. The Hollywood climate is too balmy. Chemists have come to the rescue, and photographers' "hypo" has been substituted for the ice.

For example, the motion-picture director is desirous of staging a supposed Canadian championship skating tournament. Following the suggestion of Professor Arthur R. Maas, industrial chemist



Camera with the device which made the picture on opposite page

of the University of Southern California, he now buys a ton or two of hypo. The chemical is spread about the premises, groomed with a hot iron, cooled, and is ready for the skaters. All of the fancy stunts done on ice seem equally well performed on hypo, and the movie patron doesn't know the difference.

Hypo is known to chemists as a compound of sodium thiosulfate with a considerable quantity of water. At normal temperatures it is a dry, glassy, but somewhat soft solid of much the same texture as ice. Unlike ice, however, it melts at 118 degrees instead of 32. At the elevated temperature it dissolves in its own water of crystallization, and is easily applied to the surface which is to represent a frozen lake.

Under the pressure of the running skate, hypo is scored much as ice. Semi-transparent flakes and grains fly into the air during the course of the movie drama. Under the eye of the camera the delusion is almost perfect. At the end of the day, a gentle sprinkling, followed by a hot iron, restores the fake ice to its pristine luster.

The use of the crystalline thiosulfate has been proposed for amusement rinks, but would likely have too stiff a competition from artificial ice as now employed. On the vaudeville stage, as well as in the "movies," it has been successful. It is possible that some new and cheaper material of moderately high melting point may be brought forth to displace ice, thus eliminating the high cost of refrigeration.—*Science Service.*

The FLORSHEIM SHOE

APPEARANCE . . . *smart good looks* . . . for the man who keeps his feet well dressed. You will always have style as you like it, *in* FLORSHEIM SHOES, with comfort and service assured.

THE ROLLS—*Style* M-326

Most Styles $10

THE FLORSHEIM SHOE COMPANY

Manufacturers *Chicago*

Gain new vigor From Sunshine

Ten minutes a day with this amazing new "sunshine" lamp builds health, strength, vitality in a natural way. Renews health at its source—the blood cells, the nerve centers, the internal glands. Aches, pains and diseases are overcome. Tired nerves are soothed and revitalized. Tones up system, clears the skin, improves beauty, builds resistance to disease. Colds relieved and prevented. Approved by Doctors and Hospitals. Anyone can use. Write today for illustrated FREE folder, *new low price* and easy payment plan.

CINCINNATI AUTOMATIC MACHINE CO.
Dept. 93, Cincinnati, Ohio

250 POWER MICROSCOPE

OWN this fine, laboratory type instrument . . . same as used by Scientists, Physicians, Dentists and professional Physicists. Has quick adjustment by knurled nuts both sides of tube. Special device protects slides from breakage. Triple divisible objective gives different powers and large, clear field of great depth. Square stage with clips. Adjustable iris diaphragm, with plane and convex mirrors. Adjustable stand. A precision microscope complete with handsome case. Save money . . . buy direct—money refunded if not absolutely satisfied after 30 day trial. Send check, money order or cash. *Catalog free.*

$16.50

Apparatus Engineering Co.,
Dept. A, 2006 Chestnut St.,
Philadelphia, Pa.

PRISMO REFLECTO

THE SUNLIT SIGN
IN THE *FLAT* FRAME

The remarkable visibility of this sign is limited only by the size of the lettering—unimpaired by rain or snow. An ingenious combination, recently patented, of prisms reflecting sunlight in the daytime and spotlight at night. Nothing to get out of order—cleaned with a garden hose. Have sold New York City ourselves and wish to expand our territory. Commissions and samples to agents wherever you may be. Local franchises given first applicants. Act now.

For further particulars address

PRISMO REFLECTO
138 East 25th Street
New York City

CHEMISTRY

Complete, practical home-study courses prepared by some of the best-known chemists in this country, including ALLEN ROGERS, B.S., M.S., Ph.D.—Head of Department of Industrial Chemistry, Pratt Institute; L. M. TOLMAN, Ph.D., Vice-president, United Chemical and Organic Products Co.; BRADLEY STOUGHTON, B.S.—Head of the Department of Metallurgy, Lehigh University, and OWEN L. SHINN, Ph.D.—Professor of Applied Chemistry, University of Pennsylvania.

Mail Coupon for Free Booklet

INTERNATIONAL SCHOOL OF CHEMISTRY
Division of the
International Correspondence Schools
Box 6103-B, Scranton, Penna.

Without cost or obligation, please send me full details of your home-study course in

☐ Analytical Chemistry ☐ Metallurgical Chemistry
☐ Chemical Engineering ☐ Short Chemistry Course
☐ Industrial Chemistry ☐ Pharmacy

Name.....

Address.....

Our Choice of Recent Books

Fundamentals of Chemistry

By Gray, Sandifur, and Hanna of Los Angeles High Schools

A FULL revision of this well-known text elucidating the latest methods of teaching both by the electronic theory and that of oxidation and reduction; the latter now such a big factor in the life of industries. Outline summaries at the end of each chapter impress the captions and subdivisions and coordinate the development of each section.

$2.00 postpaid.

Beginnings of Chemistry

By H. B. Beale

IT would be hard to imagine a more clear and simple exposition to arouse a child's interest in science than this very explicit and understandable outline of fundamentals of chemistry. It gives the story and nomenclature so that when the subject is studied, the general ideas which lay back of the words are familiar and thus lead to a clearer comprehension of the text itself. $2.65 postpaid.

Source Book of Science

By M. N. Woodring, M. E. Oaks, H. Emmett Brown of Columbia

AS a reference book for scientific interest or investigation this will be found of inestimable value. Almost any subject one may think of will be found with its bibliographical references—it might well in fact be called a scientific query book. We add it at once to our library, although it carries the rather cumbersome title "Enriched Teaching of Science in the High School." $2.75 postpaid.

Skyscrapers

By W. A. Starrett

THE author is well known as one of our foremost construction engineers. He gives a general idea of the planning and construction of a skyscraper, the essentials of its origin and the administration and functioning of a modern building organization. It is written for the layman who desires to know just how a large plan is laid out so that each step follows the other without interval. Interesting as it is instructive. $3.65 postpaid.

The A B C of Aviation

By Victor W. Pagé

AN elementary explanation of all types of aircraft illustrated by many cuts with explanatory legends connoting the text which is written in simple everyday language. $1.10 postpaid.

The Radio Manual

By G. E. Sterling, Radio Inspector, U. S. Dept. Commerce

THE general theory and practice of radio as applied to installation, upkeep, operation, and control, giving full information on broadcasting, transmitting, receiving, et cetera. A manual covering the whole subject with more advanced consideration than is usually given, although the entire treatment is surprisingly non-mathematical and clean cut.

$6.20 postpaid.

The Story of Human Progress

By Leon C. Marshall, Prof. Economics, Chicago

THIS revised edition seeks to give a coherent view of the main forces involved in living together in society—to see life as a whole. The various stages from Neolithic man down to man the idealist are limned with interesting and penetrating analysis. One cannot fail to respond to the broad viewpoint of the author.

$3.65 postpaid.

The Flight of the Southern Cross

By C. E. Kingsford Smith
C. T. P. Ulm

EIGHT thousand five hundred miles across the Pacific—the greatest flight in the history of aviation, as described by the two pilots whose accomplishment was based on most careful preparation and unfailing execution. No one who has read about the other great flights will want to miss this one—so modestly and carefully told. $2.65 postpaid.

The "Krassin"

By Maurice Parijanine

THE story of a journalist who claims to have had access to the Soviet Government reports on the rescue of the crew of the ill-fated airship *Italia*. It presents a startlingly different aspect to the whole situation than the Italian version given in Giudici's "The Tragedy of the *Italia*." Between the two books one still can but speculate as to what is the real truth. $2.50 postpaid.

Believe it or Not

By Robert L. Ripley

"RIP," the well known cartoonist of the New York *Evening Post*, gives a collection of freaks, or monstrosities which are almost impossibilities, all founded on facts which he has accumulated from travel in 64 countries and from innumerable other sources. One's credulity would not encompass such a fantastic array did he not also give the source of information in many cases. A most entertaining and unique bit of reading for lighter moments.

$2.00 postpaid.

Life and Work of Sir Norman Lockyer

By T. M. and W. L. Lockyer
With Contributions by five noted astronomers

EDISON recently said to reporters: "When a boy around 15 or 16 is found trying all kinds of experiments he shows ambition and the will to work. This boy is safe for a good career." Norman Lockyer was such a boy and his career turned out exactly according to Edison. Earning his living as a War Office clerk but devoting every spare moment to amateur astronomy he finally became Britain's most noted solar physicist, discovered helium in the sun's spectrum decades before it was found on earth, founded and for 50 years edited *Nature*, foremost English journal of science, was knighted and honored, but always retained that enthusiastic spirit that keeps the typical amateur scientist at work—"because he cannot help it." This piece of biography is romance, true romance—a book that should inspire any ambitious youth to emulation. It is not, however, a youth's book—rather, it is one you will yourself read before you present it to that lad you like to imagine as a future scientist. $7.45 postpaid.

The Sun

Charles G. Abbot; Secretary, Smithsonian Institution

MORE people would study the Sun if it were more widely realized what a multitude of things it provides for amateur scientific study and thought. Dr. Abbot, the author of "The Sun," has devoted most of his life to this work and his book, which he has now made available in a new revised edition, has long been a standard. It treats the Sun from all angles—theoretical and practical. One notable example is sunspots and the effect of variations in the Sun's radiation on our climate and daily weather. One chapter deals with that most fascinating hope of man—to obtain energy direct from the Sun's rays by the invention of efficient solar engines. A practical solar apparatus for cooking and baking in the home is also described. The book is well illustrated and has 433 pages. $3.65 postpaid.

The Spectroscopy of the Extreme Ultra-Violet

By Prof. Theodore Lyman, Emeritus Prof. Physics, Harvard

THE "extreme" ultra-violet refers to waves of higher frequency than those safe to use for therapeutic treatment—they destroy living tissue. At their highest frequency they blend into the gamut of low-frequency ("soft") X rays. These waves provide a fascinating source of study to those interested in rays and waves of all kinds. This monograph by a noted authority is a summary of our present knowledge concerning them, as learned in the laboratory. $3.90 postpaid.

Private Schools

By Porter Sargent

THIS 13th edition is a handbook and guide for parents concerning 4000 schools in this country. It gives all available data about type, courses of study, equipment, aims of education, and other pertinent facts of vital interest in selecting an education for one's children. An unique and valuable illustrated reference. $6.20 postpaid.

Summer Camps

By Porter Sargent

ONE can rely on the information given in this excellent list which has been built up to this sixth edition by intimate knowledge and persistent effort to make available exact information concerning a field of training which is growing more important each year. Numerous illustrations. $5.20 postpaid.

Bartholome de Las Cases

By Marcel Brion

A FEARLESS biography of the great Dominican missionary so well called the Father of the Indians. It is a sober estimate of his work for the oppressed as well as an exposition of the usually less accentuated fact of the high caliber of his intellect. Facts which for various reasons are frequently omitted in histories, are here included in fidelity to the purpose of the author to give as true a picture as possible. $3.20 postpaid.

Undiscovered Australia

By Capt. Sir G. H. Wilkins

RECENT interest in the author's polar flights arouses curiosity concerning his previous experiences. In this work we find a brief account of his expedition to tropical Australia during 1923–25 to collect specimens of the rarer native fauna for the British Museum. It is also a well told tale of unique and dangerous experiences. $4.70 postpaid.

The Case of Patience Worth

By Walter Franklin Prince

AN extended record of the evidence taken and sifted by Dr. Prince of a strange case of dual personality. A woman of mediocre education, by the manipulation of an ouija board shows astonishing familiarity with poetry, religion, history, belles letters, et cetera, writes admirable verse, proverbs, and dialect which even critics commend as being a remarkable achievement. Outside the psychic consideration of the case, much of this scholarly book makes interesting reading. $3.20 postpaid.

For Sale by SCIENTIFIC AMERICAN

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

"Plymouth" Is "Merely Geographical"

THE Plymouth Motor Corporation, of Detroit, is not entitled to register as a trademark for automobiles and structural parts thereof, a mark consisting of a rectangular panel containing the picture of a ship, with the words "Chrysler Plymouth" beneath, unless the word "Plymouth" be disclaimed. In his ruling to this effect, First Assistant Commissioner Kinnan held that "to the average person in this country the word 'Plymouth,' as used in the applicant's trademark, is merely geographical in its significance."

The applicant argued that the word is not merely geographical but indicates a historical event, and also that there exists a religious sect known as the "Plymouth Brethren," and a breed of chickens known as "Plymouth Rocks."

In his denial of the application, the First Assistant Commissioner stated that there is no denial of the fact that "Plymouth" is the name of an English city, and is a common geographical name in the United States. Under the present ruling, it is made clear that anyone manufacturing automobiles in Plymouth, Massachusetts, or any other town in the country which bears this name, is entitled to designate such automobiles by the name "Plymouth."

Oil Company Wins "Parco" Decision

THE privilege of using the word "Parco" to represent rust-proofing material is held by the Producers and Refiners Corporation, of Denver, Colorado. Application of the Parker Rust-Proof Company, of Detroit, Michigan, to register as a trademark for rustproofing material a mark consisting of the words "Parco Powder," has been denied by Assistant Commissioner Moore.

The opposer, the Producers and Refiners Corporation, had used the words "Parco Petroleum Products," arranged one beneath the other, with a single initial letter, the whole surrounded by a polygonal outline, as a trademark for gasoline, kerosene, and by-products thereof, especially rustproofing materials. The Parker Rust-Proof Company sought to register as a trademark for rustproofing material a mark consisting of the words "Parco Powder," arranged one beneath the other and surrounded by a diamond shaped outline.

Assistant Commissioner Moore ruled that the trademark should be denied because the marks are substantially identical and the goods of the same descriptive qualities. Both parties adopted the word "Parco" as the essential and dominating characteristic of their trademarks. The word "Powder" occuring in the applicant's mark, and the words "Petroleum Products" occuring in the opposer's mark, were disclaimed by the parties apart from their respective marks.

The difference of form of the border line was held to have no material bearing on the question of whether the two marks were confusingly similar.

With respect to the goods, the Assistant Commissioner noted that both are rustproofing materials, and said, "The applicant points out that its rustproofing material is a powder, whereas the opposer's goods do not have this property. This fact, however, does not justify the registration of the same mark by different parties where the goods of both parties are rustproofing materials. In use the applicant's material is in a liquid state. It is admitted that in its advertisements it is stated that Parco powder is an inert dry chemical which added to a tank of boiling water forms the rustproofing bath.

"It may be true that they differ from each other as to their specific composition and action on the metals, but both possess the essential rustproofing property, and when sold under the same trademark the natural inference would be that they came from the same source or have common ownership."

New York Is a State of Mind

WORDS which are geographical are not registrable in the Patent Office as trademarks. Nevertheless, it was with perfect confidence that the Levin and Harris Shirt Company sought to register "The New Yorker," written across the general outline of a tower, as a trademark for men's and boys' shirts.

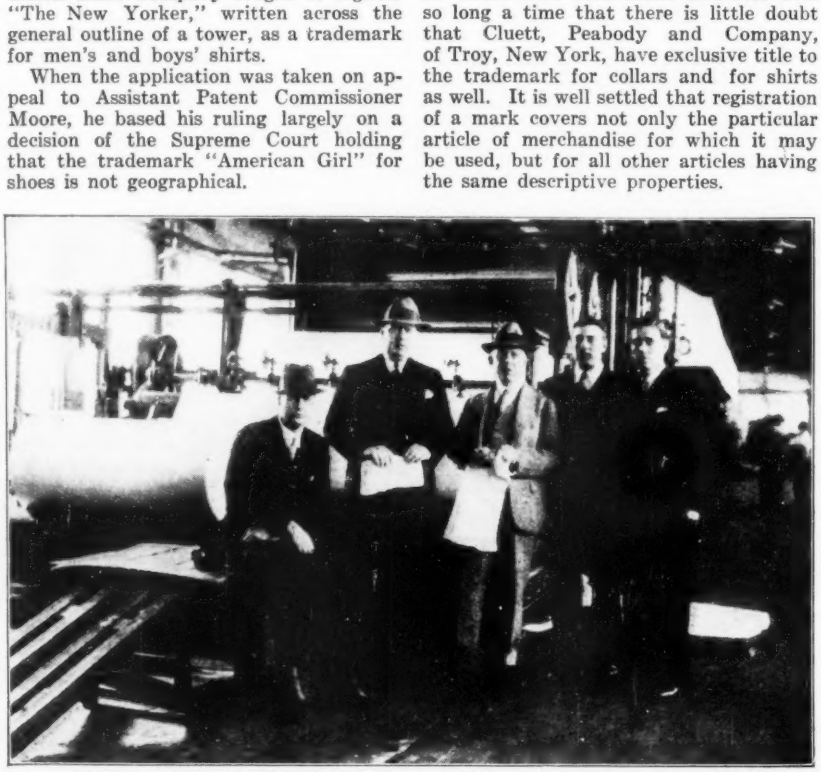
When the application was taken on appeal to Assistant Patent Commissioner Moore, he based his ruling largely on a decision of the Supreme Court holding that the trademark "American Girl" for shoes is not geographical.

"The terms 'American Girl' and 'New Yorker' are commonly employed to designate, respectively, a girl whose habitat is in America, or one whose habitat is in New York," said Assistant Commissioner Moore. "They have reference to a person, and do not in any sense have a geographical or descriptive signification with respect to the merchandise with which the terms are associated in trade. They do not signify that the merchandise is manufactured in America, generally, or in New York, specifically; nor do they indicate the quality or characteristics of the merchandise. They are fanciful terms arbitrarily selected to designate the manufacturers or owners of the respective articles of merchandise to which they are appropriated.

"In view of the above I am of the opinion that the appellant's trademark is registrable, and that the requirement that the words 'The New Yorker' be disclaimed should not be insisted upon. The decision of the examiner of trademarks is reversed."

Collars and Collar Buttons

EVERYBODY who reads advertisements knows of "Arrow" collars. So much money has been spent in popularizing the name and so many millions of collars have been made and sold over so long a time that there is little doubt that Cluett, Peabody and Company, of Troy, New York, have exclusive title to the trademark for collars and for shirts as well. It is well settled that registration of a mark covers not only the particular article of merchandise for which it may be used, but for all other articles having the same descriptive properties.



Bond paper from cornstalks is produced in this paper plant at Taylorville, Illinois. It has been found that a mixture composed of 70 percent cornstalk pulp and 30 percent wood pulp will yield an excellent quality paper. The picture shows officials of the paper company inspecting their new product

But how about the collar buttons which hold the shirts and collars together? Since suspenders have been held to be of the same descriptive properties as shirts and underwear, surely collar buttons would fall in the class with collars. So reasoned Cluett, Peabody and Company, and sought to cancel the registration of the trademark "Arrow" registered for collar buttons by the Arrow Emblem Company. First Assistant Patent Commissioner Kinnan, however, held otherwise.

"Since collar buttons are used solely to hold the collars or the shirts in place," he said, "they, like garters or suspenders, are wearing apparel and are goods having the same descriptive properties. The fact can not be overlooked, however, that collar buttons are generally made of metal, and this is specifically true of the registrant's goods, and metal working is not usually done in the same factories which would make the collars or shirts. There is a wider distinction in the mind of the purchasing public between metal goods of the kind here being considered and woven or knitted fabrics made into garments and collars as are the petitioner's goods. There is an inherent difference that would not be readily overlooked by purchasers notwithstanding the fact, fairly established by the testimony, that both classes of goods are sold by haberdashers and are included in the general term 'men's furnishings.' "

Putting Ideas to Work

NEW "wrinkles" to meet the needs and problems of everyday life too frequently never materialize. In industry it has been found that a good method of putting ideas to work is to encourage each employee to apply his knowledge, whether gained through study or practical experience, toward developing a better solution to some of the problems of his job.

Not long ago, the Hope Natural Gas Company formed a "Coin Your Ideas Committee" for this purpose, according to a recent article in the "Wrinkle Department" of *Natural Gas*. One of the problems in the gas industry was due to moisture freezing in the mercury float of the orifice meter, one of the most important measuring devices used by gas companies. Expert meter men had tried for years to find a practical way to prevent the trouble, but with each recurrence of cold weather, the moisture would collect and freeze, requiring the attention of skilled repairmen.

Glenn Frum, a young man employed in the West Virginia gas fields of the Hope Natural Gas Company, saw that the best way to eliminate this expensive nuisance was to dehydrate the gas. This meant finding some practical means of extracting the moisture before it reached the float. This he did, simply by using a drying tube, such as may be found in the laboratory of any chemist.

By attaching the glass tube filled with anhydrous calcium chloride to the meter inlet, the moisture in the gas is effectively absorbed. Using this device, an orifice meter can be left in service at least three weeks before the chemical must be replaced. Formerly it was necessary to remove the accumulated moisture at least every 48 hours during cold weather.

Frum's "wrinkle" was quickly appreciated by his employers. A patent was applied for and obtained, arrangements were made with the Metric Metal Works to manufacture the Frum De-Hydrating Tube, and Glenn Frum, the young man who coined the idea, receives a royalty on every tube sold.

End-Matched Boards

THE place of the United States Army in the field of invention is one that often is overlooked. Nevertheless, the Army is constantly at work perfecting new methods and new devices which are useful not only in warfare, but in peacetime industries. Who would expect, for example, that it would be in the War Department that there would develop a new type of wooden flooring that would effect a cost saving of 30 percent. Yet that is precisely what the Quartermaster Corps has reported to the National Committee on Wood Utilization.

In co-operation with the Committee, Major W. H. Danielson, Q. M. C., Chief of Maintenance and Operation, has been working out wood utilization practices for army requirements. A new kind of soft-wood flooring has been worked out which differs from the usual type in that one end of each piece is provided with a tongue and the other end with a groove. In this manner, lumber of any length, from two feet up, can be successfully used in floor construction, there being no need of cutting back the flooring strips to the next joist, since the joints may occur between supports.

Such a floor is easily and quickly laid and the saving in both time and labor usually varies from 20 to 30 percent, and even more. In addition, one does not find any flooring ends lying around the building job in cases where end-matched lumber is used.

Considering that soft-wood flooring in Washington today is worth in excess of 100 dollars per thousand feet, it is easily seen that it does not require much of an accumulation of flooring ends to run into money.

"Pullman" Bags and Pullman Cars

WHEN the public sees the word "Pullman" applied to an article, it assumes that the article is a part of the service identified with a certain type of railroad car known by the name of Pullman. This reason, coupled with the fact

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

SHOE ARCH SUPPORT—Comprising a plurality of superposed arch supporting springs, normally bowed, but which may be adjusted as desirable or necessary, for properly resting the foot of the wearer. Patent 1698635. Thomas H. Joyce, 2413 Cropsey Ave., Brooklyn, N. Y.

SHOE COUNTER—So formed that the counter will hug the last snugly at all points, including the upper edge at the back of the heel portion of the last. Patent 1699474. Frank L. Mason and Antonio Gagliardi, 1087 East 3rd St., Brooklyn, N. Y.

UNDERGARMENT—Which permits of the use of freely moving non-elastic shoulder straps, but having elastic means normally hidden by the garment, particularly adapted for brassieres and the like. Patent 1699923. Anna Rothstein, 4911 No. Bernard St., Chicago, Ill.

Chemical Processes

PROCESS FOR RECOVERING OILS FROM EMULSIONS—Comprising thoroughly mixing metallic sodium and calcium carbide with the emulsion to cause chemical reaction, whereby the water and oil are separated into strata. Patent 1700627. Samuel W. Cole, Box 1266, Beggs, Okla.

Designs

DESIGN FOR A SLIPPER BODY—Patent 77448. Herman Wilhelm, c/o Bernard Bernbaum, 1440 Broadway, New York, N. Y.

DESIGN FOR A DRESS—Patent 77557. Dorothy M. Long, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A RADIO CABINET—Patent 77595. Harry J. Frenz, 3449 Rorer St., Philadelphia, Pa.

Electrical Devices

SADIRON—An electrical heating unit by which steam can be generated as desired and applied to the garment during the normal pressing operation of the iron. Patent 1697224. Louis S. Butman, 1087 West Ocean Ave., Long Beach, Calif.

FLASH LIGHT—Capable of being readily positioned on a horizontal support, and its lamp housing adjusted laterally, thus eliminating holding the lamp to secure the desired rays. Patent 1699927. Merle M. Stearns, 225 Barnett St., Ventura, Calif.

RADIO RECEIVING CIRCUIT—Which will operate a loud speaker, is capable of picking up distant transmitting stations, and which can be operated at a minimum cost. Patent 1700652. Christian K. Schenck, 422 W. 115 St., New York, N. Y.

Of General Interest

KITCHEN-UTENSIL SUPPORTER—Having a plurality of supporting hooks and recesses so arranged that a maximum of space, and supporting means are provided for articles in a relatively small device. Patent 1697711. Arthur Brown, Grand Ave and Babylon Turnpike, Freeport, L. I., N. Y.

PASTRY MIXER—Comprising two similarly formed elements of sheet metal, each having raised rubbing members for effectively gripping the pastry dough and causing the same to be thoroughly worked. Patent 1697837. James M. Sudduth, 319 Madison Ave., Pierre, S. D.

SLIDING DOOR—In which a plurality of sections flexibly united may be readily shifted on a turn, and which will insure against leakage when the door is closed. Patent 1697772. James A. Lewis, 59 Summit St., Newton, Mass.

FASTENING DEVICE—Employing a stationary arm and a movable arm, and means for preventing the rotation of the fastening device after it has been inserted in a fabric or other article, thereby producing a device which cannot be accidentally removed. The inventor has been granted two patents, 1696284 and 1696285. Frederick C. Rile, 6022 Calumet Ave., Chicago, Ill.

COMB—In which the teeth are provided with absorbent pads which may be gently run over the scalp, for the application of an oil, or tonic to the hair. Patent 1698631. Harry H. Hutchings, 220 W. 42nd St., New York, N. Y.

OIL CAN—Including a pump assemblage, a piston rod extending through the top of the can and means for limiting the piston stroke, and a discharge tube and nozzle. Patent 1698632. Fred I. Jaden, Hastings, Neb.

SLIDING DOOR—Which will require but little manual effort to raise or lower, thus rendering the door particularly applicable to crowded structures where it is impossible to employ swinging doors. Patent 1698675. Thomas H. Cromer, Box 550, Greenville, S. C.

STOCKING FRAME—Constructed to adjustably accommodate stockings of different sizes and kinds, especially silk, and to maintain the stocking in proper shape, while drying, after being washed. Patent 1697968. Gene G. Beckhardt, 475 17th St., Brooklyn, N. Y.

BAG LOCK—Including flanges and prongs which coact with means for releasably holding the buckle clasp of a hand bag, pocketbook or brief case, in adjustable position. Patent 1698657. Daniel I. Reiter, 142 5th Ave., New York, N. Y.

CARD CASE—In which business or calling cards can be kept, carried, and protected against being soiled, yet can be singly projected from the case and thus readily withdrawn. Patent 1697266. Raymond J. Opfergelt, 115 W. 64th Place, Inglewood, Calif.

WALL WIRES—For use in cement wall construction, for holding the forms, the wires are previously shaped, and may be easily withdrawn and the holes made water tight. Patent 1697354. Karl O. Gober, 3025 Richmond Blvd., Oakland, Calif.

ROAD MAP—Of a size which may be conveniently held and manipulated by one hand, the leaves being turned by the thumb for easy consultation, while the vehicle is under way. Patent 1697350. William C. Eubank, 1002 Santa Fe Bldg., San Francisco, Calif.

HOSE COUPLING—Especially adapted to garden or fire hose, may be firmly secured to a faucet, and has novel means for securing the sections to provide leak-proof joints. Patent 1698195. Victor Karbowski, c/o Rev. F. S. Feldheim, 1534 Wilder St., Evanston, Ill.

ADVERTISING NOVELTY—Which includes telescopically slidable elements upon which figures and scenes are printed, the scenes and figures being simultaneously exposed with projection and display of the elements. Patent 1699383. Reuben Le G. Taylor, c/o Blanchard Press, 418 W. 25th St., New York, N. Y.

BOOK RACK—A substantial rack, supported from a bed rail and readily adjustable for holding a book, magazine or the like in open position convenient for reading. Patent 1699176. Adolph E. Zaremba, 2021 Milan Ave., South Pasadena, Calif.

COMBINED HINGE, COMPACT PLATE HOLDER AND EJECTOR—Formed of wire bent to extend beneath the compact plate and then into a position for acting as a pintle for the hinge of a vanity case. Patent 1700059. William G. Kendall, 118 Market St., Newark, N. J.

CLOTHESLINE-SUPPORTING MEANS—For what are commonly termed "endless pulley lines," which admits of the full use of the clothesline for support, precludes displacement, and permitting tensioning of the line. Patent 1699630. John T. Pilkington, Hotel St. Claire, Detroit, Mich.

that it is clearly the name of an individual and is also a geographical name in Illinois, was cited by Assistant Commissioner Moore in his decision holding that the F. H. White Company, of Philadelphia, is not entitled to register the name "Pullman" as a trademark for traveling bags and suitcases.

In his decision, Assistant Commissioner Moore pointed out the prohibition against the registration of names of individuals and corporations, unless written in a particular manner, and noted the applicant's argument that the dominating significance of the term is a certain well-known type of railroad car.

"I am of the opinion that the registration of the mark should be denied on either of the statutory grounds above named," he said. "It is clearly the name of an individual, also, of the Pullman firm or corporation, and is not written, printed or impressed in any distinctive manner. It is also the geographical name of the place in Illinois where the Pullman sleeping car and palace car are manufactured.

"To apply the word 'Pullman' to traveling bags and suit cases indicates to the public that such bags and suit cases are part of the Pullman service."

The American Beauty Contest

WHEN Joseph W. Sheridan, of Quincy, Illinois, sought to register as a trademark for ice cream cones a mark consisting of the words "The American Beauty Rose" arranged in a shield shaped border with a picture of a rose on one side, strenuous objection was made by the National Biscuit Company. The biscuit company is the owner of a trademark consisting of the words "American Beauty" and a picture of two roses as a trademark for crackers and biscuits. The new mark, they protested, was closely similar to theirs.

First Assistant Commissioner Moore agreed with them. Nevertheless he permitted the registration on wholly different grounds. He found that ice cream cones and crackers are made of the same material, and, in some cases, are made by the same manufacturers, but that despite this, there was little likelihood that confusion would result.

"It must be understood," he said, "that the opposer (the National Biscuit Company) sells its goods in small packages and they reach the ultimate consumer, as a general rule, in such packages. On the other hand, the applicant sells his ice-cream cones to the ultimate consumer one at a time and not as a separate commodity, but as a receptacle for the ice cream sold with it. The consumer may be said never to ask for the applicant's goods apart from the ice cream, but substantially always to ask for the ice cream and to receive the container as an incident of the purchase.

"It has not been overlooked that the opposer has shown its goods are sold in packages to druggists and dispensers of confections and ice cream and that such merchants or dispensers buy the applicant's product in small packages or cartons. Such purchasers, however, are of a character that would be less likely to be misled by the similarities of the mark upon these specifically different goods. They are not of the class wherein the class of purchasers was stated to be persons unable to read, including children, servants, foreigners, and uneducated persons, as well as those ordering the goods over the telephone."

POLICE CLUB—Having laterally projecting spurs, normally protected within the surface but movable to active position for puncturing an automobile tire, dragging objects from a river or other necessary uses. Patent 1700023. Jacob D. Capriles, 30 Prinsenstraat, Curacao, Dutch West Indies.

BUILDING CONSTRUCTION—By means of blocks, which are fireproof and non-conductors of heat, may be readily assembled or taken apart, and will form a building readily heated. Patent 1699651. Lewis C. Bennett, 5807 Blackstone Ave, Chicago, Ill.

LIQUID CONTAINER—Formed flat throughout and divided interiorly into a plurality of independent compartments with an independent outlet for each compartment and removable closure for each outlet. Patent 1700623. Etta M. Bleecker, c/o Miss E. M. Squies, Amityville, L. I., N. Y.

MASSAGE APPARATUS—Having handles at its ends and roller elements at its intermediate portions, can be conveniently washed with soap and water without injury, having no metal parts to rust. Patent 1700633. Abram A. Hendrickson, Prospect Ave., Oradell, N. J.

FLOOD-TIDE AND BACKWATER VALVE—For preventing backwater from entering a cellar, affording a maximum clearance for the escape of foreign matter, and the prevention of valve closing. Patent 1700636. Albert M. Khun, 120 Union St., Elizabeth, N. J.

BAG HOLDER—A metal strip, so bent to form that it will provide greater facilities for the insertion, retention and dispensing of bags used generally in retail stores, may be easily supported. Patent 1700641. Jack Medlock, Grandfield, Okla.

Hardware and Tools

DEVICE FOR CUTTING GLASS—By means of which, one who is not particularly skilled in glass cutting may make a clean cut along a perfectly straight line with an ordinary glass cutter. Patent 1697044. Joseph Burda, 2743 Southport Ave., Chicago, Ill.

CHEESE-CURD KNIFE—Combining two standard types of knives in one, whereby the operator can cut a cheese into cubes by moving the knife across the length and width of the vat. Patent 1695761. John H. Hecker, c/o Douglas Cheese Asso., Gardnerville, Nevada.

WRENCH—The fixed jaws having an opening of general egg-shape, the movable jaws having opposed angular faces, which may be easily adjusted and secured. Patent 1697764. Peter M. Heinz, 350 Grandview Ave., Dubuque, Iowa.

PADLOCK—In which the shackle is arranged to be entirely removed from the cooperating body portion of the lock, and a simple means employed for locking the core in position. Patent 1698201. Joseph Pietrie, 2219 Iowa St., Chicago, Ill.

DOUBLE BULL HOOK—With means for readily connecting the ends of a plurality of ropes in such manner that they will be firmly held against disengagement during variations of the pull. Patent 1699381. Stanley B. Stewart, 220 So. King St., Centralia, Wash.

HACK-SAW FRAME—Of telescopic and adjustable form, in order that the depth may be varied to accommodate a deeper cut, and adjustable to accommodate blades of various lengths. Patent 1699291. Samuel W. Halbert, 518 So. Tremont St., Los Angeles, Calif.

DRILL BIT—For well drilling, particularly adapted for soft formations, constructed to clear the hole as it goes, permitting the pipe to follow, and drills with great rapidity. Patent 1698873. Ralph K. Burke, 225 Oxford Ave., Lindsay, Calif.

VALVE—For quickly coupling female and male members with the end of a globe valve casing, and controling the water supply to a hose or other conduit. Patent 1700073. William H. Parker and Charles A. Taylor, 330 Clarkson St., Denver, Colo.

SAFETY DEVICE FOR GAS COCKS—Automatically operable to keep the cock closed and prevent unintentional flow of gas, but readily operated to permit intentional flow, may be easily associated with a gas cock. Patent 1700063. Max Krueger, 36 Thames St., Brooklyn, N. Y.

HOSE CLAMP—Comprising wire coils formed in such manner that the wire extends completely around the hose thereby leaving no open spot at which a leak may occur. Patent 1700043. Fred W. Gunn, 318 Columbus Ave., Boston, Mass.

BORING TOOL—In which an auger bit associated with a pair of milling cutters, will drill a square opening, leaving only a pair of small fillets for removal by hand. Patent 1700654. Fred R. Stelzenmuller, Box 127, River Road, Delawanna, N. J.

Heating and Lighting

METHOD OF AND APPARATUS FOR DRYING COMBUSTIBLE MATERIALS—By a furnace, and a revolving drum, whereby the moisture of lignite coal, as it comes from the mine, is reduced to about 15%, best adapted for combustion. Patent 1697268. Hansen Evesmith, c/o Scranton Collieries Corp., Scranton, North Dakota.

OIL STOVE—With means for facilitating the lighting of the principal wick, by merely turning on the main wick oil supply, a continuous pilot light being used for ignition purposes. Patent 1699411. Chris M. Thomsen, c/o E. J. Burnham, 836 Huntington Blvd, Pomona, Calif.

Machines and Mechanical Devices

KEY - DUPLICATING MACHINE — Having specially formed work and pattern holding clamps, for securing a cylinder key and a blank, while the blank is being cut to reproduce the pattern. Patent 1697747. Frederick A. Bachman, 268 Summit St., Union City, N. J.

SEPARATOR—In the form of a dust collector, for use in separating, in an efficient and clean manner pulverulent, powdered, or finely comminuted solids from air laden therewith. Patent 1697743. George C. Webster, c/o Davidson & Forsythe, 436 Barrington St., Halifax, N. S., Canada.

DEVICE FOR REDUCING THE SKIN AND WAVE RESISTANCE OF MOVING BOATS—A compressed fluid apparatus, for discharging air jets over the hull at points of greatest resistance to the water, thus permitting the boat to attain a greater speed. Patent 1697257. Boris Anissimoff, Box 1052, Manila, Philippine Islands.

MANUFACTURE OF DIE CASTINGS—Comprising a mold and a fluid actuated plunger which recedes under the action of fluid entering the mold, thus eliminating blow holes, especially in thick castings. Patent 1697741. Conrad Vaughan, c/o Forrester, Kelley & Co., Attrs., Birmingham, England.

TEXTILE-FINISHING MACHINE—Wherein feeding drums are so mounted with relation to the finishing rollers as to facilitate the operation of rubbing the textile, to impart a high luster. Patent 1697736. Frederick W. P. Rose and Christian Werner, c/o Werner & Co., 183 Autumn St., Passaic, N. J.

DEVICE INSURING IN A CONTINUOUS AND AUTOMATIC MANNER THE SYNCHRONISM BETWEEN A GRAMOPHONE AND A CINEMATOGRAPHIC PROJECTION MACHINE—For the purpose of giving the phonetical reproduction accompanied by the optical reproduction of a moving picture. Patent 1697695. Luigi Robimarga, c/o Letterio Laboccetta, Via Due Marcelli 31, Rome, Italy.

SAFETY DEVICE FOR EXTRACTORS—For preventing the opening of the cover of a laundry machine while the working parts are in operation, or starting the machine while the cover is open. Patent 1697798. Charles W. Terwilliger, 476 Eastern Parkway, Brooklyn, N. Y.

DRY-CLEANING APPARATUS—A compact device which may be manually or mechanically operated and controlled, which will reduce to a minimum the loss of non-explosive cleansing fluid, permitting the fluid to be used over and over again. The inventor has been granted two patents, 1697766 and 1697767. Maurice DeW. Hirst, 1612 Market St., Philadelphia, Pa.

VENDING MACHINE FOR STATIONERY—For discharging by gravity sheets of writing paper simultaneously with a stamped envelope, upon the insertion of a coin of predetermined size. Patent 1698644. John H. McCutchen, 1 So. Main St., Memphis, Tenn.

CASTING MACHINE—Particularly adapted for making dental castings of metal, porcelain, or suitable material for inlays, backings, dummies, crowns, bridges, plates, regulating appliances and the like. Patent 1698197. John A. Lentz, 117 East Palm Lane, Phoenix, Arizona.

SLUG MAGAZINE FOR EXTRUDING MACHINES—Whereby slugs are accurately positioned to be regularly fed into the machine, and are resiliently clamped to prevent them entering the magazine in an improper manner. Patent 1699504. Frank J. Lynch, c/o Sun Tube Corp., Hillside, N. J.

DEEP-WELL PUMP—Adapted to automatically take up wear between the plunger and the cylinder wall, and prevent sand from becoming lodged between the plunger and barrel, whereby leakage is prevented. Patent 1699036. Ralph B. Welsh, Box 299, Burkburnett, Texas.

RETURN TRAP—For installation in steam systems for receiving and returning the water of condensation to the boiler, all the working parts being housed for eliminating air from the system. Patent 1699464. Charles H. Dutcher, c/o Kieley & Muller, Inc., 34 W. 13th St., New York, N. Y.

LARD-REFINING DEVICE—Comprising a receptacle in which the refining is more thorough, uniform, and more rapid, with less manual labor, and which obviated the need of using crushed ice. Patent 1698756. James S. Hunter, 37 No. Halsted St., Chicago, Ill.

SELECTOR MECHANISM FOR PLEATING MACHINES—For rendering one of the pleating knives inoperative upon any desired stroke of the machine in order that straight, box or other types of pleating may be produced. Patent 1699340. Louis Angelus, c/o Circle Pleating Machinery Co., 625 6th Ave., New York, N. Y.

SIGNALING DEVICE FOR MACHINES—Adapted to warn the operator of a machine each time one of the parts attains the limit of function, the limit being determined in advance for the several elements. Patent 1700068. Henri Meurin, c/o C. Bletry, 2 Boulevard de Strasbourg, Paris, France.

ROTARY-SHAFT LOCK—Which prevents rotation of the shaft except by movement of a driving member, which produces a torque on said shaft, particularly suited for use on dumb-waiters. Patent 1700049. Richard R. Haupt, Jr., and Walter F. Haupt, 652 High St., Newark, N. J.

TUNNELING DEVICE—Adapted to bore holes in the ground beneath streets, houses or the like for laying pipes without injury in any way to the structure above. Patent 1699936. Henry M. Watchorn, 217 So. Popular St., Sapulpa, Okla.

TRIGGER MECHANISM FOR FIREARMS—Whereby a military rifle can be discharged with but relatively light finger pressure, disturbing the marksman's aim obviated, and the rifle rendered adaptable for sportsman's use. Patent 1699881. Francis K. Elliott, 354 West Ave. 45, Los Angeles, Cal.

APPARATUS FOR TEMPERING SOLE LEATHER—Wherein the leather stock will be held separated, submerged in water for a predetermined period, removed, enclosed, and shut off circulating air, to obtain a complete saturation. Patent 1700653. Charles Shaw, 6430 Woodbine St., Brooklyn, N. Y.

Medical Devices

SANITARY SHIELD—Of transparent material, will effectively shield the eyes, nose and mouth of an operator, and is adapted to be readily supported from the ears, eyeglasses, or an opthalmoscope. Patent 1697733. William A. Poole, McClelland Bldg., Lexington, Ky.

OBSTETRICAL INSTRUMENT—Embodying a pair of separable handles and a flexible loop, which after being correctly positioned about the infants head, may be maintained under tension, and manipulated with one hand. Patent 1690942. Edwin O'Dell, Central City, Nebraska.

SHEEP-DOSING DEVICE—A syringe for administering liquids, having a rigid tube, and a resilient tube, large enough and sufficiently rigid to prevent doubling, yet small enough for use on lambs. Patent 1699590. Joseph W. Ireland, c/o Noorman Mfg. Co., Chicago, Ill.

Musical Devices

COLLAPSIBLE STRINGED INSTRUMENT—A practice instrument, which will have the natural feel of a regular instrument, and may be played in an apartment without annoyance to occupants of neighboring apartments. Patent 1699384. Livingston Welch, 229 E. 79th St., New York, N. Y.

COMBINATION MAGNET AND PRIMARY VALVE—A unit in which the primary valve and the electromagnet for actuating it, are so combined as to control the flow of air in a pipe organ. Patent 1699363. August A. Klann, Park Station, Waynesboro, Va.

Prime Movers and Their Accessories

SPARK-PLUG TESTER—Which may be employed to test the spark under substantially the same degree of compression as it will be subjected to in practice, thereby readily indicating defects. Patent 1700026. Carman S. Cole, c/o Naval Air Station, Anacostia, D. C.

Railways and Their Accessories

AIR-BRAKE LEVER MECHANISM—For use on railway cars, and other vehicles, wherein a cushioned effect is given the braking action, and a maximum leverage secured with a minimum use of air. Patent 1698656. Angstadt B. Ream, 722 So. Market St., Elizabethtown, Pa.

SAFETY AND SERVICE VALUE—Equipped with automatically acting means for preventing the escape of steam, if a main valve or its casting becomes accidentally broken, particularly adapted for steam locomotives. Patent 1698616. Raybon C. Woodham, 518 Clayton St., Montgomery, Ala.

RAIL-JOINT FASTENER—Which affords facilities for securely connecting the end portions of two rails and holding them against sagging, twisting or rattling, also serving to guard the electrical bond wire. Patent 1700046. George W. Harlan, Otterville, Missouri.

Pertaining to Recreation

AMUSEMENT APPARATUS—Which gives the impression of driving an automobile over a course having straight and curved portions, and requires some skill to prevent bumping against the side rails. Patent 1700640. William F. Mangels, 2875 W. 8th St., Coney Island, N. Y.

Pertaining to Vehicles

CONTROLLING DEVICE FOR POWER TRANSMISSION FOR VEHICLES TRAVELING UPON TRACKS—Characterized by electric motors whose axes are situated in parallel verticle planes oblique to the longitudinal axis of the vehicle, and acting upon the axles near their middle. Patent 1697730. Pierre Mariage, c/o Office Picard, 97 Rue St., Lazare, Paris, France.

DRAFTING

Learn at home

F. E. KING was "a poorly paid clerk" when he enrolled for the home-study Drafting Course of the International School of Drafting. Through study and perseverance he became Chief Draftsman of the U. S. Steel Furniture Co. He is now earning more in a day than he used to earn in a week.

A. J. Hutchins became Chief Draftsman for the American Strawboard Company and increased his salary 300%—also as a result of our training.

There is no doubt that Drafting offers a real opportunity to ambitious men and it will pay you to investigate it. Mail coupon for free booklet.

INTERNATIONAL SCHOOL OF DRAFTING
Division of the
International Correspondence Schools
Box 6102-B, Scranton, Penna.
Without cost or obligation, please send me full details of your home-study course in
☐ Mechanical Drafting ☐ Structural Drafting
☐ Architectural Drafting ☐ Ship Drafting
Name.....
Address.....

ASBESTOS

All grades of Crudes and Fibres in large or small quantities

Sold by

KEASBEY & MATTISON COMPANY

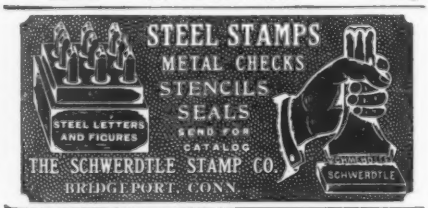
Ambler, - Penna.

Branches in Principal Cities

CHEMISTS

Catalog listing 2500 illustrations chemists supplies, 5000 chemicals, 1000 scientific books sent for 50c.

LABORATORY MATERIALS COMPANY
637 East 71st Street Chicago



Magnified 225 Diameters
This is what the tip of a fly's leg is like when seen through the
ULTRALENS MICROSCOPE

At last a high powered microscope is within the means of all who wish to study, observe and experiment with the vast world of minute objects invisible to the naked eye. Such fun it is, as well as educational. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send $5.00 for complete outfit. Send for descriptive literature.

$5.00 for Complete Outfit Prepaid

ROAT & LOHMAN
Dept. 102 Milton, Pa

INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—APRIL, 1929

American Farm Machine Co. 376
American Lead Pencil Co. 375
American Pipe Bending Machine Co. 376
American Tobacco Company 350 & 351
Apollo Manufacturing Co. 371
Apparatus Engineering Co. 377
Atlas Indicator Works 376

Francis Bannerman Sons 375
Bartlett Hayward Company 367
Bernard & Heller 376
Charles Bond Company 373
Broderick & Bascom Rope Co. 369
Brown & Williamson Tobacco Co. 375

Chicago Stock Gear Works 373
Chicago Technical College 373
Cincinnati Automatic Machine Co. 377
Crescent Tool Company 376

Dodge Brothers Trucks Second Cover

Elec. Service & Eng. Bureau (P. O. Box 132), 376

Florsheim Shoe Company 377
B. B. Fortney 376

Gillette Safety Razor Company 290
Gilson Manufacturing Company 372

Alexander Hamilton Institute 375
Heath Airplane Company 372
Hill, London, England 376

Ideal Linoleum Top Company 376
International Correspondence Schools 377 & 384
International Ticket Scale Corp. 353

Kansas Seed Company 376
Keasbey and Mattison 384
John F. Keller 376

Laboratory Materials Co. 384
Los Angeles Chamber of Commerce 294

Masonite Corp. 347
Mead Cycle Company 372
Metal Cast Products Co. 373
Metallic Sign Letter Co. 376
Milwaukee Die Casting Company 365
Munn & Co. 374 & 376

New York Life Insurance Co. 361
Northern Engineering Works 357

Packard Motor Car Co. Third Cover
Prismo Reflecto 377
Psychic Baseball Corp. 376

R. J. Reynolds Tobacco Co. Fourth Cover
Roat & Lohman 384
Ruxton-Multi-Vider Corp. 373

Schwerdtle Stamp Co. 384
Science News Letter 375
Charles A. Scott 376
James Sinclair 376
S K F Industries, Inc. 289
Square Deal Supply Co. 373
Stephenson Laboratory 373
Studebaker Corp. of America 363
Stuebing Cowan Company 355

Timken Roller Bearing Company 292
Tropical Service Bureau 376

Unisol Mfg. Company 376
United Electric Motor Co. 374

Veeder-Root, Inc. 374

Waco Tool Works, Inc. 373
Wells Portrait Studios 376
Western Electric Company 349
Westinghouse Elec. & Mfg. Co. 359

Henry Zuhr, Inc. 376

Advertising Representative
Blanchard-Nichols-Coleman
Chicago, Los Angeles, San Francisco
Seattle and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 24-26 West 40th Street, New York

ORSON D. MUNN, President
JOHN P. DAVIS, Treasurer
LOUIS S. TREADWELL, Vice-President
I. SHELDON TILNEY, Secretary

EDITORIAL STAFF

ORSON D. MUNN, Editor

ALBERT A. HOPKINS ALBERT G. INGALLS LOUIS S. TREADWELL
A. P. PECK F. D. MCHUGH HENRY W. HOUGH
PROFESSOR HENRY NORRIS RUSSELL PROFESSOR ALEXANDER KLEMIN

CORRESPONDING EDITORS

ERNEST W. BROWN, Sterling Professor of Mathematics, Yale University.

A. E. BUCHANAN, Jr., Lehigh University, Assistant Secretary of the American Institute of Chemical Engineering.

MORRIS FISHBEIN, M.D., Editor of the *Journal of the American Medical Association* and of *Hygeia*.

WILLIAM K. GREGORY, Professor of Vertebrate Paleontology, Columbia University.

LEON A. HAUSMAN, Professor of Zoology, New Jersey College for Women.

PAUL R. HEYL, Physicist, United States Bureau of Standards.

DAVID STARR JORDAN, Chancellor Emeritus, Leland Stanford Jr. University.

WALDEMAR KAEMPFFERT, Director Rosenwald Industrial Museum, Chicago.

M. LUCKIESH, Director, Lighting Research Laboratory, National Lamp Works of General Electric Company, Nela Park, Cleveland.

D. T. MACDOUGAL, Associate in Plant Biology, Carnegie Institution of Washington.

ROY W. MINER, American Museum of Natural History.

RUSSELL W. PORTER, Optical Associate, Jones and Lamson Machine Company, Associate in Optics and Instrument Design, California Institute of Technology.

DR. WALTER FRANKLIN PRINCE, Research Officer, Boston Society for Psychic Research.

ELIHU THOMSON, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

R. W. WOOD, Professor of Experimental Physics, Johns Hopkins University.

Vol. 140, No. 4. Price 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year postage prepaid.

Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Registered United States Patent Office.